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Produktivnost dela skozi prizmo bibliometrične analize

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Povzetek:
Ozadje in izvirnost: Študija se osredotoča na analizo razvoja koncepta 'produktivnost dela', ki se je v zadnjih 90 letih izpostavil kot temeljni pojem v okviru ekonomike poslovanja. Je prva takšna študija na tako velikem obsegu znanstvenih člankov.
Metoda: Avtorja sta uporabila bibliometrično analizo, natančneje analizi sočasne pojavnosti in sklopljenosti. Pri tem sta analizirala 13.575 člankov iz baze Web of Science.
Rezultati: Identificirane so spremembe paradigem in intelektualni razvoj na področju produktivnosti dela ter razmišljala o možnih usmeritvah prihodnjih raziskav. Kot najbolj verjetno možnost sta izpostavila povezavo koncepta produktivnosti dela z idejo transhumanizma, ki si prizadeva za združitev človeka in inovacij na področju umetne inteligence.
Družba: Rezultati študije silijo k ponovnem premisleku o nevarnostih, ki jih nakazujejo trendi združevanja človeka in tehnologije.
Omejitve/nadaljnje raziskovanje: V prihodnosti bi se lahko analiziralo več ključnih besed, ki pomensko sodijo v okvir produktivnosti dela ter bi se lahko uporabila še kakšna druga baza podatkov.

Ključne besede: ekonomika, produktivnost, delo, transhumanizem.

1 Uvod

Pogosto imenovan kot 'oče znanstvenega managementa', Frederic Taylor, se je že v začetku 20. stoletja osredotočil na analizo produkcijskih procesov in njihovo optimizacijo, pri čemer je bil glavni poudarek na povečanju učinkovitosti s standardizacijo dela (Taylor, 2004; Taneja, Pryor, & Toombs, 2011). Njegova ideja o dvigu

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produktivnosti je dosegla vrhunec, ko jo je v praksi uporabil industrialec Henry Ford, ki je v svojem podjetju vpeljal principe taylorizma in jih nadgradil, pri čemer je ključno novost predstavljala uvedba tekočega traku in s tem detajlno specializiranih zaposlenih (Watson, 2019). Med Taylorjeve naslednike lahko štejemo tudi Eltona Maya (1923), ki je prispeval naslednji pomemben korak v raziskovanju produktivnosti dela. Poudarjal je psihološki aspekt vpliva na učinkovitost delavcev pri delu in je eden od začetnikov preučevanja "medčloveških odnosov". Peter Drucker je nadaljeval raziskave s prehodom od preučevanja produktivnosti proizvodnih delavcev k preučevanju "znanjskih" delavcev (Drucker, 1999). Kljub kritikam, da sta taylorizem in fordizem temeljila na nekaterih pristopih, ki so pozneje zaznamovani kot nehumani, so principi teh teorij še vedno ključni pri sodobnih pristopih k povečanju produktivnosti dela. V tej luči ni presenetljivo, da se v današnjem času z željo po večji učinkovitosti in možnostmi, ki jih ponuja tehnologija, povečuje nadzor, ki prinaša tako koristi kot tudi nevarnosti (Huang, Tung, Lo, & Chou, 2013). V tej luči se danes vse bolj pojavljajo koncepti, ki zagovarjajo ne le tehnologije v vlogi pripomočka človeku, temveč tehnološko izboljšanega človeka. Integracija tehnologije in človeka, ki naj bi implicirala novo izjemno rast produktivnosti, se najpogosteje označuje s pojmom transhumanizem. Slednji kot filozofsko in intelektualno gibanje zagovarja izboljšanje človeških sposobnosti z uporabo tehnologije z namenom preseganja trenutnih fizičnih in mentalnih omejitev (Tirosh-Samuelson, 2012). Vendar pa ob odprtju veliko novih možnosti pojav transhumanizma nosi tudi številne nevarnosti.

Fenomen produktivnosti dela ni bil preučevan le s strani navedene peščice avtorjev, ampak je v zadnjem stoletju pritegnil na tisoče znanstvenikov in strokovnjakov, vključno z vsemi tistimi, ki se ukvarjajo z ekonomiko podjetja in ekonomiko države. To odražajo številni znanstveni in strokovni članki, posvečeni tej temi. Najbolj znana svetovna baza znanstvenih člankov, Web of Science (WoS), je do leta 2022 dokumentirala kar 66.956 prispevkov s ključnimi besedami 'produktivnost dela' ali 'delovna produktivnost'. Produktivnost dela je ključna za različna področja, od tistih, kjer prevladuje fizično delo, kot so delo na gradbiščih (El-Gohary & Aziz, 2014; Naoum, 2016), do tistih, kjer se osredotoča na učinkovitost zaposlenih z visoko stopnjo znanja (Letvak & Buck, 2008; Palvalin, 2019). Poleg tega se produktivnost dela preučuje tako pri delih, ki se izvajajo na lokaciji nastanka produkta (Cai, Lu, & Wang, 2018) kot tudi pri delih na daljavo (Galanti, Guidetti, Mazzei, Zappalà, & Toscano, 2021). Ker je produktivnost dela pomembna tako za posameznika kot družbo, se meri tako na individualni (Rosekind et al., 2010) kot na državni ravni (Bloom, Draca, & Van Reenen, 2016). Kako pomembna je za človeštvo produktivnost dela, je razvidno tudi iz tega, da so industrijske revolucije zaznamovane ravno s skoki v rasti produktivnosti.

Za razumevanje koncepta produktivnost dela je pomembno razumeti njegovo intelektualno in konceptualno strukturo ter razvoj področja skozi čas. Prav tako je

pomembno ugotoviti raziskovalne interese v današnjem času in odkriti možne prihodnje smeri razvoja tega koncepta, ki je v središču vsakega gospodarskega in družbenega razvoja. V okviru prizadevanja za osvetlitev zgodovinskega razvoja in možnosti predvidevanja za prihodnost smo v tej študiji izvedli bibliometrično analizo proučevanega koncepta. Pri tem smo uporabili različne bibliometrične analize na podlagi predlogov Zupica in Čaterja (2015). Za osvetlitev konceptualnega razvoja področja smo uporabili analizo sočasne pojavnosti, medtem ko smo za preučitev intelektualne strukture področja produktivnosti dela in njegove morebitne prihodnje smeri uporabili tehniko analize bibliografskega sklopljenosti.

Rezultati študije omogočajo razmišljanje o tem, kaj lahko pričakujemo v prihodnosti glede koncepta produktivnosti dela, kar lahko koristi managerjem na vseh organizacijskih ravneh, tako v podjetjih kot v drugih organizacijah, in tudi političnim odločevalcem pri oblikovanju zakonodajnega okvira za iskanje ravnotežja med ambicijo po povečanju produktivnosti ter željo po ohranjanju integritete in zaščiti temeljnih človekovih pravic delavcem. Poleg ponujanja odgovorov na vprašanja o razvoju koncepta skozi čas in sodobnih orodjih za povečanje produktivnosti dela ter možnih scenarijih za prihodnost, je ta raziskava tudi osnova za morebitne nadaljnje študije, saj lahko raziskovalci iz nje črpajo ideje za kvalitativno nadgraditev kvantitativnih ugotovitev iz te študije.

2 Metoda

Kot izhodišče raziskave je bila uporabljena podatkovna baza Web of Science (WoS). V njej smo najprej iskali zadetke na temo 'produktivnost dela' (labor productivity) ali 'delovna produktivnost' (work productivity), potem pa smo le in le-te filtrirali glede na temo citiranja v področjih 'ekonomija' in 'management', ter iskanje omejili na leto 2022. Zbrali smo 13.575 člankov. Izvozili smo celoten zapis in citirane reference v besedilni datoteki. V 13.575 člankih smo našli 357.447 referenc.

Za ugotavljanje intelektualnega in konceptualnega razvoja skozi čas smo podatkovni niz razdelili na štiri podnize in analizirali sočasno pojavnost ključnih besed (Lamovšek & Černe, 2023; Ramos-Rodríguez & Ruíz-Navarro, 2004; Ronda-Pupo & Guerras-Martín, 2010; Zhao & Strotmann, 2008). Prvi niz se nanaša na obdobje od leta 1937, ko je bil objavljen prvi raziskovalni članek, do leta 2007, oz. do začetka finančne/gospodarske krize. Drugi se nanaša na obdobje od leta 2008 do 2015, ki označuje obdobje prehoda iz krize v okrevanje, ko se je v javnosti vse bolj izpostavljal pomen in potreba po prehodu v okviru četrte industrijske revolucije. Tretje obdobje označuje tisto med leti 2016 in 2019, v tem času se je že razpravljalo o učinkih četrte industrijske revolucije. Zadnje obravnavano obdobje označuje tisto med leti 2020 in 2022, ki ga je zaznamovala kriza Covid-19. Za odkrivanje novih raziskovalnih tem in možnih prihodnjih smeri smo izvedli analizo bibliografske sklopljenosti le za zadnje obdobje (Martín-de Castro, Díez-Vial, &

Delgado-Verde, 2019). Rezultate kvantitativne bibliometrične analize smo nadgradili s kvalitativno analizo literature.

3 Rezultati

3.1 Sočasna pojavnost v obdobju 1932 - 2007

V analizi sočasne pojavnosti od leta 1932 do leta 2007 je bilo analiziranih 2679 člankov. Pri analizi je bil uporabljen način štetja vseh ključnih besed avtorjev. Minimalna pojavnost ključnih besed je bila nastavljeno na 5, kar je iz 2970 ključnih besed izluščilo njih 122, ki so dosegle prag. Posledično se je oblikovalo 13 skupin oz. grozdov s ključnimi besedami in temami, kot so navedene v tabeli 1 in 2. Skupna moč povezave je znašala 752, s 555 povezavami med temi ključnimi besedami. Največji grozdi govorijo o ekonomskih konceptih, organizacijskem vedenju in upravljavskih praksah, trgu dela in gospodarskem razvoju ter tehnologiji in človeškem kapitalu.

Tabela 1
Analiza sočasne pojavnosti od leta 1932 do leta 2007 (1. del)

Število ključnih besed v grozdu	Ključne besede v izvirniku (angleščina)	Ključne besede v slovenskem jeziku	Glavna tema grozda
16	cointegration, competition, efficiency wages, endogenous growth, equilibrium unemployment, firm performance, inflation, migration, optimal taxation, Phillips curve, privatization, profit sharing, trade, transition, unemployment, wage bargaining	kointegracija, konkurenca, učinkovitost plač, endogena rast, uravnotežena brezposelnost, uspešnost podjetja, inflacija, migracija, optimalna obdavčitev, Phillipsova krivulja, privatizacija, delitev dobička, trgovina, tranzicija, brezposelnost, pogajanja o plačah	Temeljni ekonomski/gospodarski koncepti
14	adverse selection, downsizing, human resource management, incentives, job design, knowledge management, knowledge sharing, learning, organizational change, organizational performance, Taiwan, teams, teamwork, transition economies	Negativna selekcija, zmanjševanje, upravljanje s človeškimi viri, spodbude, oblikovanje delovnih mest, upravljanje znanja, deljenje znanja, učenje, organizacijske spremembe, organizacijska uspešnost, Tajvan, ekipe, timsko delo, tranzicijska gospodarstva	Organizacijska dinamika - organizacijsko vedenje in upravljavske prakse
14	agricultural productivity, capital utilization, DEA,	Kmetijska produktivnost, izraba kapitala, DEA	Merjenje in analiza dejavnikov

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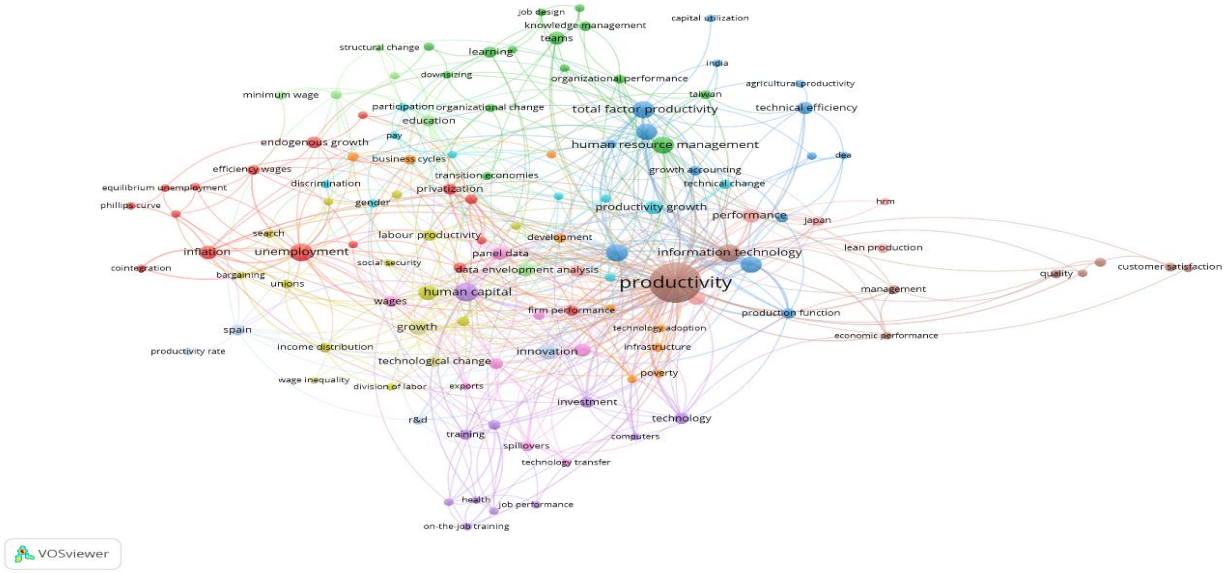
	economic growth, efficiency, growth accounting, India, labor productivity, new economy, production function, productivity analysis, tehnical efficiency, TFP, total factor productivity	(analiza paketa podatkov), gospodarska rast, učinkovitost, računovodstvo rasti, Indija, delovna produktivnost, nova ekonomija, proizvodna funkcija, analiza produktivnosti, tehnična učinkovitost, celovita faktorska produktivnost (TFP).	produktivnosti in gospodarske rasti
12	bargaining business cycle, developing countries, division of labor, economic development, employment, income distribution, labor hoarding, labor productivity, search, social security, unions	Pogajalski poslovni ciklus, razvijajoče se države, delitev dela, gospodarski razvoj, zaposlovanje, razdelitev dohodka, zadrževanje delovne sile, produktivnost dela, iskanje, socialna varnost, sindikati.	Trg dela in gospodarski razvoj
11	computers, health, human capital, investment, job performance, job satisfaction, labor demand, on-the-job-training, overeducation, technology, training	Računalniki, zdravje, človeški kapital, naložbe, delovna uspešnost, zadovoljstvo pri delu, povpraševanje po delovni sili, usposabljanje na delovnem mestu, prekvalificiranost, tehnologija, usposabljanje	Tehnologija, človeški kapital in trg dela
10	competitiveness, discrimination, flexibility, gender, Latin America, participation, pay, productivity growth, strategic human resource management, technical change	Tekmovalnost, diskriminacija, prilagodljivost, spol, Latinska Amerika, participacija, plačilo, rast produktivnosti, strateško upravljanje s človeškimi viri, tehnična sprememba	Dinamika trga dela
9	business cycle, depression, development, inequality, infrastructure, labour market, matching, poverty, technology adoption	Poslovni ciklus, depresija, razvoj, neenakost, infrastruktura, trg dela, ujemanje, revščina, uvedba tehnologije	Gospodarski in socialni dejavniki

Tabela 2
Analiza sočasne pojavnosti od leta 1932 do leta 2007 (2. del)

Število ključnih besed v grozdu	Ključne besede v izvirniku (angleščina)	Ključne besede v slovenskem jeziku	Glavna tema grozda
9	customer satisfaction, economic performance, information technology, management, performance measurement, productivity, quality, service quality, total quality management	Zadovoljstvo strank, gospodarska uspešnost, informacijska tehnologija, upravljanje, merjenje uspešnosti, produktivnost, kakovost, kakovost storitev, skupno upravljanje kakovosti	Strategije in metrike za izboljšanje poslovanja
8	China, export, externalities, foreign direct investment, panel data, spillovers, technology transfer, wages	Kitajska, izvoz, zunanji učinki, tuje neposredne naložbe, panelni podatki, prenosi, prenosi tehnologije, plače	Mednarodna trgovina in gospodarski odnosi
6	convergence, HRM, Japan, lean production, manufacturing, performance	Konvergenca, upravljanje s človeškimi viri, Japonska, vitka proizvodnja, proizvodnja, uspešnost	Vitka proizvodnja
6	data envelopment analysis, education, minimum wage, regional convergence, structural change, wage, differentials	DEA (analiza paketa podatkov), izobraževanje, minimalna plača, regionalna konvergenca, strukturne spremembe, plača, razlike	Ekonomska analiza, dohodki, regionalni razvoj
4	innovation, productivity rate, R&D, Spain	Inovacije, stopnja produktivnosti, raziskave in razvoj, Španija	Inovativnost
3	growth, technological change, wage inequality	Rast, tehnološke spremembe, neenakost plač	Gospodarski razvoj in dinamika dela

Na spodnji *Sliki 1* se vidi vizualni rezultat bibliometrične analize sočasne pojavnosti med leti 1932, ko je bil najden prvi članek v bazi podatkov WoS, in 2007, ko se je začela gospodarska kriza. Velikost točk ključnih besed je povezana s frekvenco njihove pojavnosti. Različne barve predstavljajo skupine ključnih besed. Najštevilčnejši je rdeči grozd, ki je sestavljen iz 16 ključnih besed.

Slika 1
Analiza sočasne pojavnosti od leta 1932 do 2007



3.2 Sočasna pojavnost med leti 2008 in 2015

Pri analizi sočasne pojavnosti od leta 2008 do 2015 smo analizirali 3956 primarnih člankov. Pri analizi smo uporabili način štetja vseh ključnih besed. Minimalna pojavnost ključnih besed je bila nastavljena na 12, kar je skrčilo izbor na 118 od 7449 ključnih besed, ki so izpolnile prag. Tako je bilo oblikovanih 8 skupin. Skupna moč povezave je bila 1884, s 1050 povezavami med temi ključnimi besedami. Najštevilčnejši je bil grozd s 25 ključnimi besedami, katerega glavna tema je bila mednarodna trgovina in globalizacija. Sledi grozd, ki govori o organizacijski in individualni uspešnosti, nato grozd o gospodarski rasti (tabela 3).

V sliki 2 vidimo 8 grozdov. Velikost posamezne točke (ključne besede) v grozdu predstavlja moč povezave posamezne ključne besede. Ravno tako se lahko razbere, katere so osrednje ključne besede, katere obrobne in katere povezovalne. Primer osrednje ključne besede je *»productivity«*, primer povezovalne je *»efficiency«,* primer stranske pa *»stress«*.

Slika 2
Analiza sočasne pojavnosti med leti 2008 in 2015

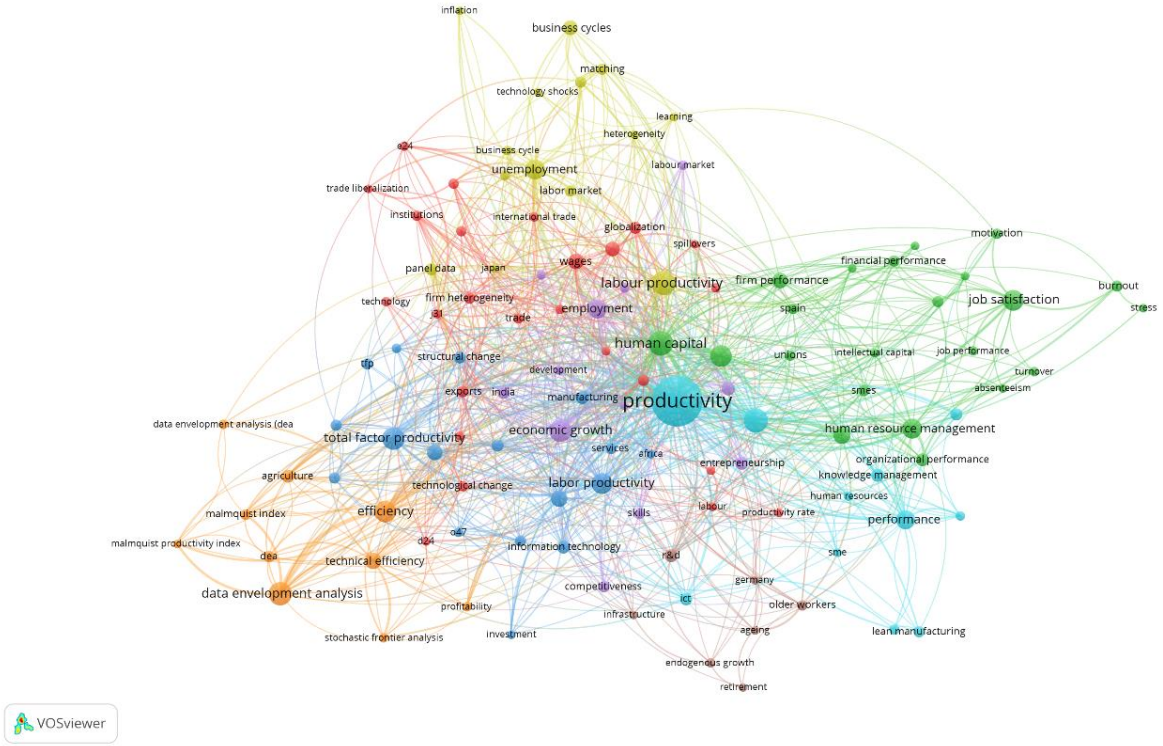


Tabela 3
Analiza sočasne pojavnosti med leti 2008 in 2015

Število ključnih besed v grozdu	Ključne besede v izvirniku (angleščina)	Ključne besede v slovenskem jeziku	Glavna tema grozda
25	d24, e24, export, FDI, firm heterogeneity, foreign direct investment, globalization, heterogenous firms, industrial firms, industrial relations, institutions, international trade, j31, labour, o33, outsourcing, productivity rate, spillovers, technological change, technology, technology transfer, trade, trade liberalization, trade unions, wage inequality, wages	d24, e24, izvoz, tujih neposrednih naložb (FDI), heterogenost podjetij, tuje neposredne naložbe, globalizacija, heterogeni izvajalci, industrijska podjetja, industrijski odnosi, institucije, mednarodna trgovina, j31, delo, o33, izvajanje storitev, stopnja produktivnosti, prenosi, tehnološke spremembe, tehnologija, prenos tehnologije, trgovina, liberalizacija trgovine, sindikati, neenakost plač, plače	Globalna gospodarska dinamika
22	absenteeism, burnout, business performance, China, corporate social responsibility, financial performance, firm performance, high-performance work, human capital, human resource management, intellectual capital, job performance, job satisfaction, motivation, organizational commitment, organizational performance, SMEs, Spain, stress, training, turnover, unions	odsotnost z dela, izgorelost, poslovna uspešnost, Kitajska, korporativna družbena odgovornost, finančna uspešnost, uspešnost podjetja, visoko učinkovito delo, človeški kapital, upravljanje s človeškimi viri, intelektualni kapital, delovna uspešnost, zadovoljstvo pri delu, motivacija, predanost organizaciji, organizacijska uspešnost, MSP-ji, Španija, stres, usposabljanje, fluktuacija zaposlenih, sindikati	Organizacijska in individualna uspešnost
17	Africa, competition, convergence, growth, growth accounting, information technology, investment, labor productivity, manufacturing, O47, production function, productivity growth, services, structural change, TFP, total factor productivity, Turkey	Afrika, konkurenca, konvergenca, rast, računovodstvo rasti, informacijska tehnologija, naložbe, produktivnost dela, proizvodnja, O47, proizvodna funkcija, rast produktivnosti, storitve, strukturne spremembe, TFP, celotna faktorska produktivnost, Turčija	Gospodarska rast produktivnost in strukturne spremembe
14	business cycle, business cycles, heterogeneity, inflation, Japan, labor market, labour productivity, learning, matching, panel data, search, search and matching,	Poslovni ciklus, heterogenost, inflacija, Japonska, trg dela, produktivnost dela, učenje, ujemanje, panelni podatki, iskanje, iskanje in ujemanje, tehnološki šoki, brezposelnost	Makro-ekonomski kazalniki

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12	competitiveness, development, economic development, economic growth, education, employment, entrepreneurship, India, inequality, labour market, Latin America, skills	konkurenčnost, razvoj, gospodarski razvoj, gospodarska rast, izobraževanje, zaposlovanje, podjetništvo, Indija, neenakost, trg dela, Latinska Amerika, veščine	Gospodarski razvoj in dinamika trga dela
11	creativity, human resource, ICT, innovation, knowledge management, knowledge work, lean manufacturing, management, performance, productivity, SME	ustvarjalnost, človeški viri, informacijska in komunikacijska tehnologija (IKT), inovacije, upravljanje z znanjem, znanstveno raziskovalno delo, vitka proizvodnja, upravljanje, uspešnost, produktivnost, mala in srednje velika podjetja (MSP)	Produktivnost, inovativnost in uspešnost
10	agriculture, data envelopment analysis, data envelopment analysis, DEA, efficiency, Malmquist index, Malmquist productivity profitability, stochastic frontier analysis, technical efficiency	kmetijstvo, analiza paketa podatkov (DEA), učinkovitost, Malmquistov indeks, Malmquistova produktivnostna dobičkonosnost, analiza stohastičnih mej, tehnična učinkovitost	Učinkovitost
7	ageing, endogenous growth, Germany, infrastructure, older workers, R&D, retirement	staranje, endogena rast, Nemčija, infrastruktura, starejši delavci, raziskave in razvoj, upokojitev	Notranja rast, starajoča se delovna sila

3.3 Sočasna pojavnost med leti 2016 in 2019

V analizi sočasne pojavnosti med leti 2016 in 2019 je bilo analiziranih 3600 primarnih člankov. Pri tem je bil uporabljen način polnega štetja ključnih besed avtorjev. Minimalna pojavnost ključnih besed je bila določeno na 11, kar je impliciralo, da je 114 ključnih besed izmed 8032 doseglo prag analize. Te so oblikovale 8 grozdov. Skupna moč povezav je bila 1753 z 966 povezavami med ključnimi besedami. Najštevilčnejši grozd vključuje predvsem teme o delu in povezanih konceptih, ki vplivajo na produktivnost dela. Sledi grozd, katerega skupni imenovalec je avtomatizacija in trajnost. Temu sledi grozd gospodarske dinamike in konkurenčnosti (tabela 4).

Na spodnji sliki 3 lahko vidimo vizualen rezultat analize sočasne pojavnosti za obdobje med letoma 2016 in 2019. Na sliki 3 lahko vidimo 8 grozdov. Najštevilčnejši je rdeč grozd z 31 ključnimi besedami, sledi mu zelen grozd, ki vsebuje 19 ključnih besed.

Slika 3
Analiza sočasne pojavnosti v obdobju 2016 - 2019

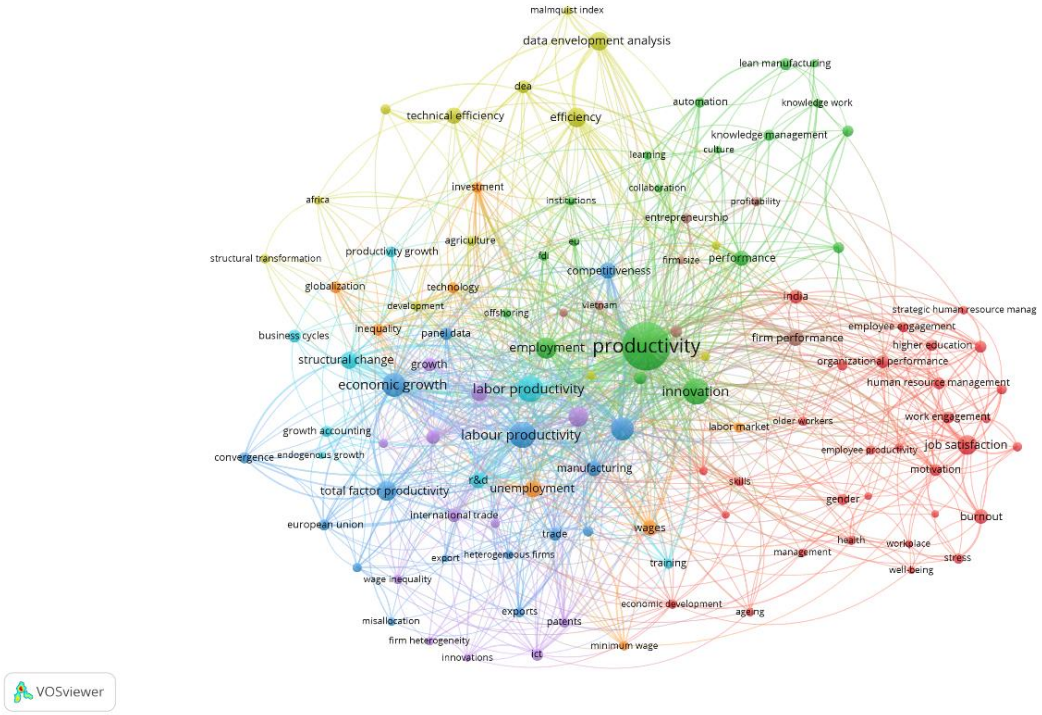

Tabela 4
Analiza sočasne pojavnosti med leti 2016 in 2019

Število ključnih besed v grozdu	Ključne besede v izvirniku (angleščina)	Ključne besede v slovenskem jeziku	Glavna tema grozda
31	absenteeism, ageing, burnout, economic development, employee engagement, employee productivity, gender, health, high-performance work, higher education, human resource management, human resource, India, information and communication technologies, information technology, job performance, job satisfaction, leadership, management, motivation, older workers, organizational commitment, organizational performance, quantitative, skills, strategic human resource management, stress, well-being, work engagement, work place	absentizem, staranje, izgorelost, gospodarski razvoj, angažiranost zaposlenih, produktivnost zaposlenih, spol, zdravje, visoka delovna učinkovitost, višje izobraževanje, upravljanje človeških virov, človeški viri, Indija, informacijsko-komunikacijske tehnologije, informacijska tehnologija, delovna uspešnost, zadovoljstvo pri delu, vodstvo, upravljanje, motivacija, starejši delavci, organizacijska zavezanost, organizacijska uspešnost, kvantitativno, spretnosti, strateško upravljanje človeških virov, stres, blagostanje, angažiranost pri delu, delovno mesto	Delo

»se nadaljuje«

»nadaljevanje«	automation, collaboration, corporate social responsibility, culture, education, employment, EU, FDI, innovation, institutions, knowledge management, knowledge work, lean, lean manufacturing, learning, offshoring, performance, productivity, sustainability	avtomatizacija, sodelovanje, družbena odgovornost podjetij, kultura, izobraževanje, zaposlovanje, EU, neposredne tuje investicije, inovacije, institucije, upravljanje znanja, znanstveno delo, vitko, vitka proizvodnja, učenje, selitev produkcije v tujino, uspešnost, produktivnost, trajnost	Avtomatizacija in trajnost
19			
16	competitiveness, convergence, economic growth, EU, export, firm productivity, heterogeneous firm, human capital, labour productivity, manufacturing, misallocation, panel data, TFP, total factor productivity, trade	konkurenčnost, konvergenca, gospodarska rast, EU, izvoz, produktivnost podjetja, heterogeno podjetje, človeški kapital, delovna produktivnost, proizvodnja, nepravilna porazdelitev, panelni podatki, TFP, skupna produktivnost, trgovina	Gospodarska dinamika in konkurenčnost
13	Africa, agriculture, Bangladesh, data envelopment analysis (DEA), development, efficiency, labour market, Malmquist index, stochastic frontier analysis, structural transformation, technical efficiency, wage	Afrika, kmetijstvo, Bangladeš, analiza paketa podatkov (DEA), razvoj, učinkovitost, delovni trg, Malmquistov indeks, analiza stohastičnih mej, strukturna transformacija, tehnična učinkovitost, plača	Učinkovitost
12	China, firm heterogeneity, foreign direct investment, growth, ICT, income distribution, industry, innovations, international trade, patents, technological change, wage inequality	Kitajska, heterogenost podjetij, tuje neposredne investicije, rast, informacijsko-komunikacijske tehnologije, razdelitev dohodka, industrija, inovacije, mednarodna trgovina, patenti, tehnološke spremembe, neenakost plač	Rast, heterogenost in inovativnost
8	business cycles, endogenous growth, growth accounting, labor productivity, productivity growth, R&D, structural change, training	poslovni cikli, endogeni rast, računovodstvo rasti, delovna produktivnost, rast produktivnosti, raziskave in razvoj (R&D), strukturne spremembe, usposabljanje	Rast in produktivnost delovne sile
8	globalization, inequality, investment, labour market, minimum wage, technology, unemployment, wages	globalizacija, neenakost, naložbe, trg dela, minimalna plača, tehnologija, brezposelnost, plače	Globalizacija in neenakost
7	competition, entrepreneurship, firm performance, firm size, profitability, SMEs, Vietnam	konkurenca, podjetništvo, uspešnost podjetja, velikost podjetja, dobičkonosnost, MSP-ji (mala in srednje velika podjetja), Vietnam	Konkurenca in podjetništvo

3.4 Analiza sočasne pojavnosti obdobju od leta 2020 do leta 2022

V analizi sočasne pojavnosti v obdobju 2020 - 2022 je bilo analiziranih 3340 primarnih člankov. Pri tem je bil uporabljen način polnega štetja ključnih besed avtorjev. Minimalna pojavnost ključnih besed je bila določena na 12, kar je izluščilo 113 ključnih besed izmed skupno 8488. Te so oblikovale 6 grozdov. Grozdi s številom ključnih besed, ključne besede in osrednjimi temami so prikazani v spodnji tabeli 5. Skupna moč povezav je bila 2003 s 1110 povezavami med navedenimi ključnimi besedami. Glavne teme grozdov so v tem obdobju bile: delo, gospodarski razvoj, konkurenca ter umetna inteligenca in digitalizacija.

Na spodnji sliki lahko vidimo 6 različnih grozdov analize sočasne pojavnosti med letoma 2020 in 2022. Najštevilčnejši je rdeč grozd s temo dela, ki je sestavljen iz 33 ključnih besed. Sledita mu zelen in nato rumen grozd.

Slika 4
Analiza sočasne pojavnosti v obdobju 2020 - 2022

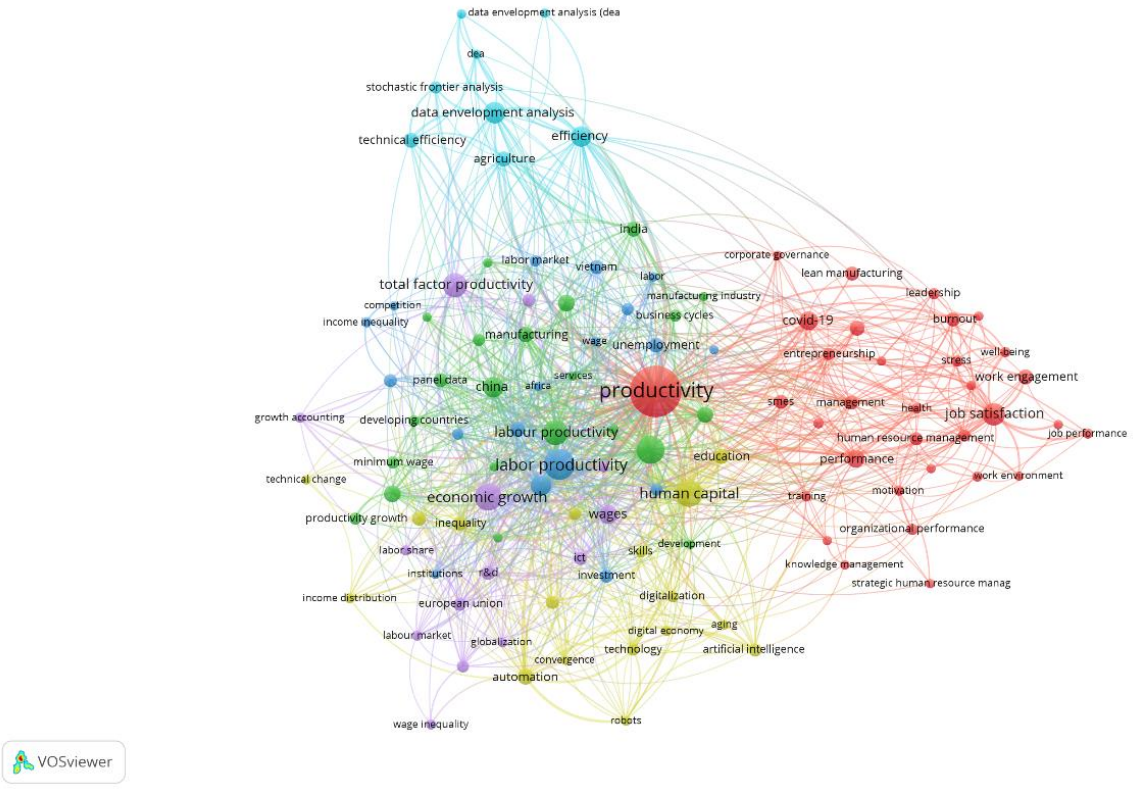

Tabela 5
Analiza sočasne pojavnosti v obdobju 2020 – 2022

Število ključnih besed v grozdu	Ključne besede v izvirniku (angleščina)	Ključne besede v slovenskem jeziku	Glavna tema grozda
33	burnout, corporate governance, covid-19, employee engagement, employee performance, employee productivity, employees, entrepreneurship, health, higher education, human resource management, job performance, job satisfaction, knowledge management, knowledge sharing, leadership, lean manufacturing, management, motivation, occupational health, organizational commitment, organizational performance, performance, productivity, SMEs, strategic human resource management, stress, sustainability, training, well-being, work engagement, work environment, working conditions	izgorelost, korporativno upravljanje, covid-19, angažiranost zaposlenih, delovna uspešnost zaposlenih, produktivnost zaposlenih, zaposleni, podjetništvo, zdravje, višje izobraževanje, upravljanje človeških virov, delovna uspešnost, zadovoljstvo pri delu, upravljanje znanja, deljenje znanja, vodstvo, vitka proizvodnja, upravljanje, motivacija, poklicno zdravje, organizacijska zavezanost, organizacijska uspešnost, uspešnost, produktivnost, MSP-ji, strateško upravljanje človeških virov, stres, trajnost, usposabljanje, blagostanje, angažiranost pri delu, delovno okolje, delovni pogoji	Delo
22	business cycles, China, competitiveness, developing countries, development, export, FDI, firm performance, global value chains, India, inflation, informality, innovation, labour productivity, manufacturing, manufacturing industry, minimum wage, misallocation, panel data, productivity growth, services, structural change	poslovni cikli, Kitajska, konkurenčnost, države v razvoju, razvoj, izvoz, neposredne tuje investicije, uspešnost podjetja, globalne vrednostne verige, Indija, inflacija, neformalnost, inovacije, delovna produktivnost, proizvodnja, proizvodna industrija, minimalna plača, nepravilna porazdelitev, panelni podatki, rast produktivnosti, storitve, strukturne spremembe	Gospodarski razvoj in dinamika v državah v razvoju
18	Africa, competition, employment, foreign direct investment, gender, income inequality, institutions, investment, labor, labor market, labor productivity, Nigeria, structural transformation, sustainable development, trade, unemployment, Vietnam, wage	Afrika, konkurenca, zaposlovanje, tuje neposredne investicije, spol, dohodkovna neenakost, institucije, investicije, delo, trg dela, delovna produktivnost, Nigerija, strukturna transformacija, trajnostni razvoj, trgovina, brezposelnost, Vietnam, plača	Konkurenca in neenakost
17	ageing, artificial intelligence, automation, convergence, digital	staranje prebivalstva, umetna inteligenca, avtomatizacija,	Staranje, umetna

»se nadaljuje«

»nadaljevanje«	economy, digitalization, economic development, education, growth, human capital, income distribution, inequality, robots, skills, technical change, technological change, technology	konvergenca, digitalno gospodarstvo, digitalizacija, gospodarski razvoj, izobraževanje, rast, človeški kapital, razdelitev dohodka, neenakost, roboti, veščine, tehnična sprememba, tehnološka sprememba, tehnologija	inteligenca in digitalizacija
15	economic growth, European Union, export, firm productivity, globalization, growth accounting, ICT, international trade, labor share, labour market, R&D, total factor productivity (TFP), wage inequality, wages	gospodarska rast, Evropska unija, izvoz, produktivnost podjetja, globalizacija, računovodstvo rasti, informacijsko-komunikacijske tehnologije, mednarodna trgovina, delež delavcev, trg dela, raziskave in razvoj (R&D), skupna produktivnost (TFP), neenakost plač, plače	Gospodarska rast in globalizacija
8	agriculture, data envelopment analysis, data envelopment analysis (DEA), efficiency, Malmquist productivity index, stochastic frontier analysis, technical efficiency	kmetijstvo, analiza panela podatkov (DEA), učinkovitost, Malmquistov indeks produktivnosti, analiza stohastičnih mej, tehnična učinkovitost	Analiza učinkovitosti

3.5 Analiza bibliometrične sklopljenosti od 2020 do 2022

Metoda bibliometrične sklopljenosti nam omogoča prepoznavanje trendov analiziranega področja, saj se s pomočjo te metode lahko izračuna podobnost med dokumenti na podlagi citiranih referenc. Več prekrivajočih se referenc med dvema dokumentoma namreč pomeni močnejšo povezavo med njima. Pomembno je vedeti, da je deljenje referenc med dvema dokumentoma statično skozi čas. Po drugi strani pa se so-citiranje razvija na podlagi trendov citiranja (Zupic & Čater, 2018). Analiza bibliometrične sklopljenosti nam torej omogoča ugotavljanje glavnih smeri analiziranega področja in na podlagi tega odkrivanje možnih trendov.

V okviru analize bibliografske sklopljenosti od leta 2020 do 2022 je bilo analiziranih 3340 primarnih člankov. Uporabili smo način polnega štetja, enota analize pa je bil dokument. Minimalno število citatov je bilo določeno na 21, kar je znižalo število med seboj povezanih analiziranih dokumentov na 105. Število povezav je bilo 516 in celotna moč 1846. Kot vidimo v spodnji tabeli in sliki, ki ji sledi, je število ugotovljenih grozdov 6. Največji grozd je sestavljen iz 34 dokumentov, najmanjši pa iz 4. Glavne teme grozdov so dobro počutje zaposlenih, umetna inteligenca, avtomatizacija, staranje, kmetijstvo, trajnost, gospodarska dinamika in tehnostres (tabela 6).

Na spodnji sliki 5 je vizualen rezultat analize bibliometrične sklopljenosti. Analiza je razdelila analizirana dela v 6 grozdov. Tema največjega grozda (rdeč) je dobro počutje, usposabljanje zaposlenih in upravljanje okolja. V kar 3 od 6 grozdov so teme povezane z avtomatizacijo (svetlo moder), umetno inteligenco in tehnologijo (zelen) ter z njo povezanimi temami (vijoličen).

Slika 5
Analiza bibliometrične sklopljenosti v obdobju med letom 2020 in 2022

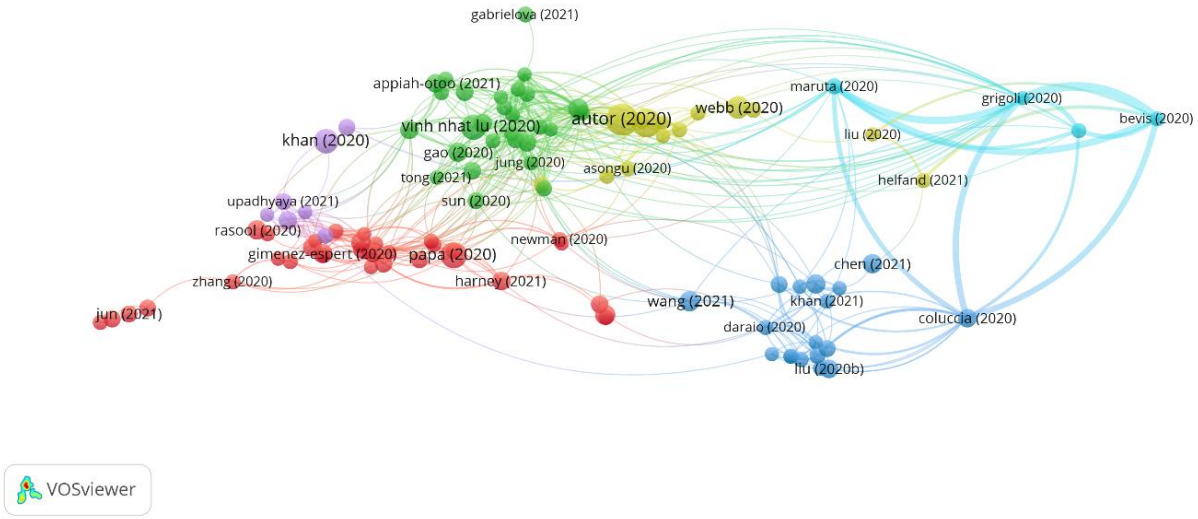

Tabela 6
Analiza bibliometrične sklopljenosti v obdobju od leta 2020 do 2022

Število člankov	Ključni avtorji	Vsebina	Glavna tema
34	Kloutsiniotis & Mihail, 2020; Lee, Malik, Rosenberger III, & Sharma, 2020; Obrenovic, Jianguo, Khudaykulov, & Khan, 2020; Troth & Guest, 2020; Zhang & Ma, 2021	V tem grozdu najdemo analize, ki segajo od individualne ravni do ravni podjetja. Članki raziskujejo organizacijsko vedenje, upravljanje človeških virov in uspešnosti. Bolj specifično obravnavajo vlogo psihologije pri upravljanju človeških virov, okoljsko upravljanje v povezavi z uspešnostjo podjetja, konfliktom med delom in družino ter psihološko varnostjo in počutjem. Poleg tega obravnavajo teme o delitvi znanja, usposabljanju zaposlenih in vedenju, ki spodbuja organizacijsko pripadnost.	Dobro počutje, usposabljanje zaposlenih, upravljanje okolja.
28	Acemoglu & Restrepo, 2022; Ciarli, Kenney, Massini, & Piscitello, 2021; Damioli, Van Roy, & Vertesy, 2021; Koch, Manuylov, & Smolka, 2021; Li, Shan, Tian, & Hao, 2020	V tem grozdu so analize večinoma na ravni države in podjetja. Teme raziskujejo razmerje med demografijo (staranje) in avtomatizacijo, dejavnike, ki spodbujajo robotizacijo v podjetjih, in pomen robotizacije. Poleg tega članki preučujejo povezavo med umetno inteligenco in produktivnostjo dela ter razmerje med stroški dela in inovacijami.	Umetna inteligenca, robotizacija, avtomatizacija in staranje.
18	Coluccia, Valente, Fusco, De Leo, & Porrini, 2020; Czyżewski, Matuszczak, Grzelak, Guth, & Majchrzak, 2021; Dagar et al., 2021; Daraio, Kerstens, Nepomuceno, & Sickles, 2020; Gołaś, Sulewski, Wąs, Kłoczko-Gajewska, & Pogodzińska, 2020	V tem grozdu je ena meta-analiza o empiričnih raziskavah na področju učinkovitosti in produktivnosti. Večina člankov raziskuje ekološko učinkovitost in trajnost v kmetijstvu. Poleg tega v grozdu najdemo tudi raziskave o razmerju med tehnično učinkovitostjo kmetov in velikostjo zemljišč.	Kmetijstvo in trajnost.
14	Autor, Dorn, Katz, Patterson, & Van Reenen, 2020; De Loecker, Eeckhout, & Unger, 2020; Hau, Huang, & Wang, 2020; Helfand & Taylor, 2021; Kehrig & Vincent, 2021	V tem grozdu so večinoma analize na ravni države in podjetja. Članki raziskujejo ekonomske dinamike in vprašanja, povezana z delom.	Gospodarska dinamika.
7	La Torre, De Leonardis, & Chiappetta, 2020; Li & Wang, 2021; Shirish, Chandra, & Srivastava, 2021; Upadhyaya & Vrinda, 2021; Zhao, Xia, & Huang, 2020	Študije so večinoma na individualni ravni. Članki v grozdu raziskujejo tehnostres v povezavi s produktivnostjo in učinkovitostjo.	Tehnostres.
4	Bevis & Barrett, 2020; Cheng, Wang, Peng, & Kong, 2020; Grigoli, Koczan, & Topalova, 2020; Maruta, Banerjee, & Cavoli, 2020	V tem grozdu so analize, ki segajo od ravni države do posameznika. Članki v grozdu raziskujejo avtomatizacijo in delovno silo; kakovost institucij in gospodarsko rast; produktivnost kmetov; investicije in učinkovitost.	Avtomatizacija.

4 Razprava

Rezultati analize sočasne pojavnosti in bibliometrične analize sklopljenosti prikazujejo napredek raziskav produktivnosti dela skozi čas. Časovna obdobja očitno niso enako dolga. Pomembno opažanje je, da količina znanstvenih del ni bila konstantna skozi vsa obdobja. Sprva je bilo manj takšnih del, vendar se je njihovo število sčasoma povečalo, kar nakazuje na rastoče zanimanje za produktivnost dela v znanstvenem področju. Rast sledi bolj eksponentnemu kot linearnemu trendu. Poleg tega je treba opozoriti, da ima rast produktivnosti dela velik vpliv tudi na samo znanost, oz. način raziskovanja ter publiciranja rezultatov raziskav. Očitno ne gre le za povečanje števila ljudi, ki so zainteresirani za to področje, temveč razvoj tehnologije spodbuja hitrejše nastajanje znanstvenih del in izboljšuje produktivnost samih znanstvenikov. Ta razvoj prav tako spodbuja nastanek novih idej, ki odpirajo potencialne možnosti za napredek v področju produktivnosti dela. V tem kontekstu je indikativno, da tudi obdobja industrijskih revolucij niso enako dolga (glej tabelo 7). Še nedavno je namreč veljalo, da bo naše življenjsko obdobje zaznamovano s četrto industrijsko revolucija, vendar v literaturi vedno pogosteje najdemo tudi razprave o peti razvojni fazi, ki se osredotoča na nov preskok v načinih dela in implicira novo dramatično izboljšanje produktivnosti (Ali, Al-Sultan, & Al Rubaie, 2022; Rai & Rai, 2015).

Tabela 7
Značilnosti dosedanjih industrijskih revolucij

Faza industrijske revolucije	**Obdobje**	**Značilnosti**
1.	18. in 19. stoletje	Uporaba parnih strojev je zamenjala ročno izdelavo in omogočila izdelavo v masovnem obsegu. Napredek v tekstilni industriji, rudarstvu ter razvoj železniškega prometa. Rast urbanizacije in selitev prebivalstva iz podeželskih območij v mestna središča. Nastanek tovarniškega sistema proizvodnje ter vzpon delavskega razreda.
2.	Konec 19. in začetek 20. stoletja	Izraba električne energije, napredek v prometnem in komunikacijskem sektorju. Napredek avtomobilske industrije, telekomunikacij, kemijske industrije in strojništva. Uvedba množične proizvodnje ter uporaba tekočih trakov v proizvodnji. Hitra rast urbanizacije in premiki delovne sile.
3.	Pozno 20. stoletje	Spremembe v digitalni dobi ter napredna računalniška tehnologija. Avtomatizacija procesov proizvodnje, uporaba robotike in povečana digitalizacija. Uvedba in napredek interneta, mobilnih tehnologij in globalne povezanosti. Nastanek novih gospodarskih panog, kot sta IT in biotehnologija.
4.	Začetek 21. stoletja	Združevanje digitalne tehnologije, interneta stvari, umetne inteligence in robotike. Poudarek na prilagajanju izdelkov posamezniku. Spremembe v delovni sili in izobraževanju zaradi avtomatizacije in digitalizacije.
5.	Sodobnost, prihodnost?	Integracija fizičnih, digitalnih in bioloških sistemov. Osredotočenost na koncept »pametnih« in »15-minutnih« mest. Centralizacija odločitvenih procesov s prenosom individualnih odločitev na centrale.

V najdaljšem obdobju analize, ki obsega obdobje od leta 1932 do 2007, so bile raziskave osredotočene na temeljne gospodarske koncepte, poslovne cikle, gospodarsko rast, uspešnost podjetij in trg dela. V obdobju od 2008 do 2015 je bil večji poudarek na raziskave in razvoj, informacijsko-komunikacijsko tehnologijo in upravljanje s človeškimi viri. V tretjem analiziranem obdobju, ki zajema leta od 2016 do 2019, se je raziskovalni fokus usmeril na avtomatizacijo, globalizacijo, obdelave panelov podatkov, človeški kapital, rast in gospodarske krize. V zadnjem obdobju analize, ki sega od leta 2020 do

2022, pa so bile teme osredotočene na digitalizacijo, informatizacijo, visoko zmogljive delovne prakse, prilagajanje prvin in neenakost ter brezposelnost. Predvsem digitalizacija in informatizacija ter posledična brezposelnost se nanašata na vse večjo tendenco zamenjave človeka ali njegove integracije s tehnologijo.

Iz navedenega je očitno, da se raziskave vse bolj osredotočajo na visoko učinkovite prakse, povezane z avtomatizacijo in informatizacijo, ki sta tudi ključna poudarka četrte industrijske revolucije. Jasno je tudi, da so preskoki, značilni za prehode med industrijskimi revolucijami, povezani z uvedbo nove tehnologije. Prvo industrijsko revolucijo je zaznamoval parni stroj, drugo elektrika, tretjo pa internet. V četrtem obdobju je ključno povezovanje različnih tehnologij med seboj, kar predstavlja glavno značilnost te faze industrijskega napredka. Ravno združevanje digitalnih tehnologij, umetne inteligence, robotike, interneta stvari in drugih naprednih tehnologij je torej značilno za to obdobje. Digitalizacija, avtomatizacija, internet stvari, množični podatki, biotehnologija in 3D-tiskanje so namreč procesi in tehnologije, ki temeljijo na ideji povezovanja različnih tehnologij (Liao, Loures, Deschamps, Brezinski, & Venâncio, 2017). Pametni telefon je tipičen primer proizvoda četrte industrijske revolucije, ki sicer ni prinesel nove tehnologije, temveč je združil obstoječe tehnologije, kot so brezžična komunikacija, digitalni fotoaparat, internet in zaslon na dotik. Četrta industrijska revolucija, kot pravi Klaus Schwab (2017), predstavlja spremembo paradigme s potencialom globokega gospodarskega, družbenega in okoljskega vpliva. Pametni telefon je postal nepogrešljiv pripomoček za večino ljudi, saj je postal temelj komunikacije, obenem pa tudi platforma za opravljanje nalog in dostop do storitev javne uprave. Ravno dejstvo, da določenih storitev ljudje ne morejo več opravljati brez njega, je pripomoglo k temu, da se posameznik postopoma integrira s pametno tehnologijo prek pametnega telefona (Rothman, Gupta, & McEvoy, 2017). To vodi v peto industrijsko revolucijo, ki stremi k povezovanju človeka in tehnologije, namesto povezovanja različnih tehnologij. V tem kontekstu se storitve, ki jih sedaj opravljamo s tehnološkim pripomočkom (mobilnim pametnim telefonom), vse bolj lahko opravljajo prek tehnologije integrirane s človekom (podkožni čipi, ki omogočajo plačevanje ipd.).

Iz navedenega je razvidno, da se v okviru najnovejše industrijske revolucije poudarek vse bolj premika k integraciji tehnologije in človeka kot ključnega elementa. V tej luči se v četrtem obdobju industrijske revolucije, ki temelji na povezovanju tehnologije s človekom, krepi pojmovanje »transhumanizma« kot filozofskega gibanja, ki zagovarja izboljšanje človeških sposobnosti s tehnologijo s ciljem premagovanja fizičnih in mentalnih omejitev (Tirosh-Samuelson, 2012). Ta koncept ponuja številne možnosti za izboljšanje delovne produktivnosti ravno prek povezave človeka in tehnologije, kot so vmesniki med možgani in računalnikom (Geraci, 2012). Poleg tega transhumanizem poudarja napredek v medicinski tehnologiji in biotehnologiji za izboljšanje zdravja in

dolgoživosti ljudi, kar lahko pozitivno vpliva na produktivnost dela. V tem kontekstu se razvijata personalizirana medicina in zdravljenje duševnega zdravja, ki lahko zmanjšata odsotnost z dela in stres na delovnem mestu ter posledično povečata splošno produktivnost. Podjetje Neuralink, ustanovljeno s strani Elona Muska, se ukvarja s tehnologijami vmesnikov možganov in računalnika, medtem ko se z metodo CRISPR lahko odpravijo genetske omejitve za povečanje produktivnosti (Porter, 2017). Tehnologije, kot so koboti in eksoskeletoni, prispevajo k izboljšanju fizične učinkovitosti in interakciji med človekom in robotom (El Zaatari, Marei, Li, & Usman, 2019; Spektor & Fox, 2020), kar tudi lahko poveča produktivnost dela. Koncept "industrije 5.0" predvideva proizvodnjo kot trajnostni sistem, ki ga podpirajo tehnologije, kot so 5G, masovni podatki in umetna inteligenca (Huang et al., 2022). Ravno slednja igra ključno vlogo pri avtomatizaciji tako fizičnih kot analitičnih nalog, kar predstavlja nov vzvod za povečanje delovne produktivnosti (Shekhar, 2019). Iz navedenega bi lahko sklepali, da je uporaba avtomatizacije in umetne inteligence v interesu podjetij, saj takšna tehnologija dela lahko dlje in učinkoviteje kot ljudje.

Ob vsem navedenem pa je vsekakor potrebno poudariti tudi morebitne slabosti transhumanizma. Kot glavna nevarnost se zdi potencialno povečanje socialnih razlik, saj bi lahko nove tehnologije dale uporabnikom, ki si jih lahko privoščijo, prednost pred tistimi, ki do njih nimajo dostopa bodisi zaradi osebnih preferenc ali pa zaradi finančnih omejitev (Chursinova & Sinelnikova, 2024). Ob tem tisto, kar se na eni strani lahko zdi kot napredek v mentalni in fizični izpopolnitvi, lahko na drugi strani ogrozi človeškost, kot jo poznamo danes (Kass, 2003). Širjenje transhumanističnih tehnologij bi namreč lahko privedlo do večjega nadzora s strani centrov odločanja, izguba zasebnosti pa bi lahko hitro bila zlorabljena. Ljudje bi lahko postali tarča stalnega nadzora in manipulacije s strani zunanjih subjektov, kar vzbuja skrb za avtonomijo posameznika pri odločanju o lastnem življenju. Poleg tega obstajajo pomisleki glede nepredvidenih posledic manipulacije človeške biologije in zavesti. Transhumanistična izboljšanja bi lahko povzročila nepričakovane stranske učinke ali posledice, ki bi prizadele posameznike in družbo, kar predstavlja tveganja in izzive, katerih razsežnosti so večini nepredstavljive (Thompson, 2017). Čeprav je res, da bo transhumanizem v smislu povečanja človeških sposobnosti, integracije umetne inteligence ter avtomatizacije ter z izboljšanjem zdravja in blaginje verjetno pozitivno vplival na produktivnost dela, bi torej moralo obstajati več neodvisnih regulatornih mehanizmov v družbi, ki bi spremljali, da ne bi morebitni negativni vidiki transhumanizma prevladali nad pozitivnimi.

Iz do sedaj navedenega je torej razvidno, da se v vsaki novi fazi industrijskega razvoja zmanjšuje čas, ki ga ljudje namenijo neposrednemu delu na končnih izdelkih ali storitvah, medtem ko se povečuje čas, ki ga porabijo za upravljanje s tehničnimi orodji, ki omogočajo dvig produktivnosti. To vodi k zmanjšanji potrebi po delavcih za ustvarjanje

določenega obsega proizvodov ali storitev. Posledično ni presenetljivo, da se v znanstvenih objavah v zadnjem času vse pogosteje pojavlja tema brezposelnosti. Produktivnost očitno narašča hitreje kot potrebe posameznika v sodobni družbi, kar pomeni, da je mogoče večjo količino proizvodov in storitev ustvariti z manjšim številom delavcev. Poleg tega krajši čas med večjimi preskoki v načinu dela zahteva hitrejše prilagajanje posameznikov. V preteklih industrijskih revolucijah so prilagoditve trajale več generacij, medtem ko se danes ljudje, rojeni v času tretje industrijske revolucije, že soočajo s peto fazo industrijskega razvoja. To skoraj gotovo prinaša napetost in strah pred 'zastarelostjo človeka', saj počasno prilagajanje posameznika lahko vodi v uresničitev črnih napovedi o zastarelosti koncepta homo sapiens sapiensa (Harari, 2017). Strah pred zastarelostjo in težave pri prilagajanju na nove zahteve trga dela v družbi lahko privedejo do neželenih psihičnih stanj, kot je na primer depresija, do katere pogosto pride ravno zaradi preobremenjenosti človeških možganov s podatki (Matthes, Karsay, Schmuck, & Stevic, 2020).

Nenazadnje, dramatičen porast produktivnosti in posledično večja brezposelnost na kratki rok v ospredje postavljata vprašanje, kako zagotoviti preživetje brezposelnim osebam in kako najti novo življenjsko poslanstvo za tiste, ki bi bili prisiljeni v brezdelje in bi se počutili nepomembne za družbo. Slednje lahko močno negativno vpliva na psihični razvoj posameznika, v primeru velikih števil pa tudi na celotno družbo. V tem kontekstu se postavlja vprašanje, ali lahko umetna inteligenca v celoti nadomesti človeško delo. Če bi to bilo mogoče, bi šesta industrijska revolucija lahko pomenila obdobje, ko bi bil človek izločen iz procesa proizvodnje. V tem okviru ne preseneča, da se vse pogosteje omenja ideja univerzalnega temeljnega dohodka (Bidadanure, 2019). Tudi če ta scenarij ne bi postal realnost, pa bi dolgoročno večja brezposelnost s seboj prinesla neprijetna družbena vprašanja, ki se nanašajo na preveliko število ljudi na svetu in posledično, kdo bi imel pravico odločati o pravico do razmnoževanja v prihodnosti (Greely, 2016). Jasno je, da koncept produktivnosti dela in njegova rast v povezavi z industrijskimi revolucijami odpira širše družbene dileme, ki presegajo okvir poslovnih ved in ekonomije. Razvoj tega koncepta in razreševanje navedenih dilem v prihodnosti se bo prav gotovo dotaknilo dveh osrednjih filozofskih vprašanj, in sicer »kaj pomeni biti človek« in »kakšen je smisel človeškega življenja«.

5 Zaključek

Z uporabo bibliometrične analize smo osvetlili napredovanje raziskav o produktivnosti dela skozi čas. Razvidno je, da so se raziskovalna obdobja razlikovala glede dolžine, obenem pa se je število znanstvenih del povečevalo, kar kaže na rast zanimanja za produktivnost dela v znanstvenem okolju, ki je veliko bližje eksponentnemu kot linearnemu. Rast produktivnosti dela ima pomemben vpliv tudi na procese samih

znanstvenih raziskovanj, saj so boljši tehnični pripomočki in boljša organizacija dela povečala učinkovitost znanstvenikov. Ta napredek prav tako spodbuja generiranje novih idej, ki odpirajo večje možnosti za morebitne skoke v produktivnosti dela, kar skrajšuje časovne intervale med posameznimi obdobji oz. fazami industrijskega razvoja. Zanimivo je, da tudi trajanje industrijskih revolucij ni enako dolgo, pri čemer se danes že omenja peti korak razvoja v kontekstu spremembe načina dela in povečanja produktivnosti.

V najdaljšem obdobju analize, ki obsega obdobje od leta 1932 do 2007, so bile raziskave osredotočene na temeljne gospodarske koncepte, poslovne cikle, gospodarsko rast, uspešnost podjetij in trg dela. V obdobju od 2008 do 2015 je bil večji poudarek na raziskave in razvoj, informacijsko-komunikacijsko tehnologijo in upravljanje s človeškimi viri. V tretjem analiziranem obdobju, ki zajema leta od 2016 do 2019, se je raziskovalni fokus usmeril na avtomatizacijo, globalizacijo, obdelave panelov podatkov, človeški kapital, rast in gospodarske krize. V zadnjem obdobju analize, ki sega od leta 2020 do 2022, pa so bile teme osredotočene na digitalizacijo, informatizacijo, visoko zmogljive delovne prakse, prilagajanje prvin in neenakost ter brezposelnost. Na drugi strani so ključni preskoki, značilni za industrijske revolucije, povezani z novo tehnologijo. Prva industrijska revolucija je bila zaznamovana z izumom parnega stroja, druga z elektriko, tretja z internetom. V četrtem obdobju se zdi, da je ključno povezovanje različnih tehnologij med seboj, medtem ko peti industrijski korak stremi k povezovanju tehnologije s človekom. Pri tem se pojavlja koncept transhumanizma, ki zagovarja izboljšanje človeških sposobnosti z uporabo tehnologije. To lahko pozitivno vpliva na produktivnost dela, a hkrati odpira tudi potencialne negativne vidike, kot so socialna neenakost, izguba človečnosti in zasebnosti ter druge, še nepredvidene posledice. Naraščajoča produktivnost dela in povečana brezposelnost kažeta na potrebo po razmišljanju o temeljnih družbenih spremembah, ki presegajo področje ekonomije. Predvsem je pomembno vprašanje, kako se bo človek prilagajal ne samo hitremu razvoju tehnologije, temveč tudi hitri spremembi samega človeka, ter kako bo določil svoje poslanstvo, če bo prihodnja industrijska revolucija omogočila dokončno izločanje človeka iz delovnega procesa.

Uporabljene metode imajo določene omejitve in možnosti izboljšav. V prihodnosti bi se lahko pri iskanju uporabilo več ključnih besed, ki pomensko sodijo v okvir produktivnosti dela, s čimer bi se razširil nabor analiziranih znanstvenih del, ki so lahko v našem primeru nehote izpuščena. Ravno tako bi se lahko poleg baze podatkov WoS uporabilo še kakšno drugo bazo podatkov in s tem pokrilo širši izbor revij in založnikov. Pri analizi sočasne pojavnosti je namreč lahko prišlo do nezavedne izkrivljenosti rezultatov, saj smo analizirali ključne besede avtorjev, ki so pri izbiri ključnih besed bili subjektivni. Nadalje

lahko kot potencialno izboljšavo omenimo omejitev subjektivnosti kvantitativne analize dobljenih rezultatov in nadgradnje le teh.

Reference

1. Acemoglu, D., & Restrepo, P. (2022). Demographics and automation. *The Review of Economic Studies*, *89*(1), 1-44. doi: 10.1093/restud/rdab031
2. Ali, S. H., Al-Sultan , H. A., & Al Rubaie, M. T. (2022). Fifth Industrial Revolution: (New Perspectives). *International Journal of Business, Management and Economics*, *3*(3), 196 - 212. doi: 10.47747/ijbme.v3i3.694
3. Autor, D., Dorn, D., Katz, L. F., Patterson, C., & Van Reenen, J. (2020). The fall of the labor share and the rise of superstar firms. *The Quarterly Journal of Economics*, *135*(2), 645-709. doi: 10.1093/qje/qjaa004
4. Bevis, L. E., & Barrett, C. B. (2020). Close to the edge: High productivity at plot peripheries and the inverse size-productivity relationship. *Journal of Development Economics*, *143*, 102377. doi: 10.1016/j.jdeveco.2019.102377
5. Bidadanure, J. (2019). The Political Theory of Universal Basic Income. *Annual Review of Political Science, 22*, 481-501. doi: 10.1146/annurev-polisci-050317-070954
6. Bloom, N., Draca, M., & Van Reenen, J. (2016). Trade induced technical change? The impact of Chinese imports on innovation, IT and productivity. *The review of economic studies*, *83*(1), 87-117. doi: 10.1093/restud/rdv039
7. Cai, X., Lu, Y., & Wang, J. (2018). The impact of temperature on manufacturing worker productivity: evidence from personnel data. *Journal of Comparative Economics*, *46*(4), 889-905. doi: 10.1016/j.jce.2018.06.003
8. Cheng, H., Wang, Z., Peng, D., & Kong, Q. (2020). Firm's outward foreign direct investment and efficiency loss of factor price distortion: Evidence from Chinese firms. *International Review of Economics & Finance*, *67*, 176-188. doi: 10.1016/j.iref.2020.01.008
9. Chursinova, O., & Sinelnikova, M. (2024). Post-Human and Trans-Human in the Future Perspective of the Humanity. *Filosofija. Sociologija*, *35*(1). doi: 10.6001/fil-soc.2024.35.1.4
10. Ciarli, T., Kenney, M., Massini, S., & Piscitello, L. (2021). Digital technologies, innovation, and skills: Emerging trajectories and challenges. *Research Policy*, *50*(7), 104289. doi: 10.1016/j.respol.2021.104289
11. Coluccia, B., Valente, D., Fusco, G., De Leo, F., & Porrini, D. (2020). Assessing agricultural eco-efficiency in Italian Regions. *Ecological Indicators*, *116*, 106483. doi: 10.1016/j.ecolind.2020.106483
12. Czyżewski, B., Matuszczak, A., Grzelak, A., Guth, M., & Majchrzak, A. (2021). Environmental sustainable value in agriculture revisited: How does Common Agricultural Policy contribute to eco-efficiency?. *Sustainability Science*, *16*, 137-152. doi: 10.1007/s11625-020-00834-6
13. Dagar, V., Khan, M. K., Alvarado, R., Usman, M., Zakari, A., Rehman, A., ... & Tillaguango, B. (2021). Variations in technical efficiency of farmers with distinct land size across agro-climatic zones: Evidence from India. *Journal of Cleaner Production*, *315*, 128109. doi: 10.1016/j.jclepro.2021.128109
14. Damioli, G., Van Roy, V., & Vertesy, D. (2021). The impact of artificial intelligence on labor productivity. *Eurasian Business Review*, *11*, 1-25. doi: 10.1007/s40821-020-00172-8
15. Daraio, C., Kerstens, K., Nepomuceno, T., & Sickles, R. C. (2020). Empirical surveys of frontier applications: a meta-review. *International Transactions in Operational Research*, *27*(2), 709-738. doi: 10.1111/itor.12649
16. De Loecker, J., Eeckhout, J., & Unger, G. (2020). The rise of market power and the macroeconomic implications. *The Quarterly Journal of Economics*, *135*(2), 561-644. doi: 10.1093/qje/qjz041

17. Drucker, P. F. (1999). Knowledge-worker productivity: The biggest challenge. *California management review*, *41*(2), 79-94. doi: 10.2307/41165987
18. El-Gohary, K. M., & Aziz, R. F. (2014). Factors influencing construction labor productivity in Egypt. *Journal of management in engineering*, *30*(1), 1-9. doi: 10.1061/(ASCE)ME.1943-5479.0000168
19. El Zaatari, S., Marei, M., Li, W., & Usman, Z. (2019). Cobot programming for collaborative industrial tasks: An overview. *Robotics and Autonomous Systems*, *116*, 162-180. doi: 10.1016/j.robot.2019.03.003
20. Galanti, T., Guidetti, G., Mazzei, E., Zappalà, S., & Toscano, F. (2021). Work from home during the COVID-19 outbreak: The impact on employees' remote work productivity, engagement, and stress. *Journal of occupational and environmental medicine*, *63*(7), e426-e432. doi: 10.1097/JOM.0000000000002236
21. Geraci, R. M. (2012). Cyborgs, robots, and eternal avatars: Transhumanist salvation at the interface of brains and machines. In *The Routledge companion to religion and science* (pp. 578-590). Routledge.
22. Gołaś, M., Sulewski, P., Wąs, A., Kłoczko-Gajewska, A., & Pogodzińska, K. (2020). On the way to sustainable agriculture—eco-efficiency of polish commercial farms. *Agriculture*, *10*(10), 438. doi: 10.3390/agriculture10100438
23. Greely, H. T. (2016). *The end of sex and the future of human reproduction*. Harvard University Press.
24. Grigoli, F., Koczan, Z., & Topalova, P. (2020). Automation and labor force participation in advanced economies: Macro and micro evidence. *European Economic Review*, *126*, 103443. doi: 10.1016/j.euroecorev.2020.103443
25. Harari, Y. N. (2017). *Homo deus. Kratka zgodovina prihodnosti*. Ljubljana: Mladinska knjiga.
26. Hau, H., Huang, Y., & Wang, G. (2020). Firm response to competitive shocks: Evidence from China's minimum wage policy. *The Review of Economic Studies*, *87*(6), 2639-2671. doi: 10.1093/restud/rdz058
27. Helfand, S. M., & Taylor, M. P. (2021). The inverse relationship between farm size and productivity: Refocusing the debate. *Food Policy*, *99*, 101977. doi: 10.1016/j.foodpol.2020.101977
28. Huang, K. P., Tung, J., Lo, S. C., & Chou, M. J. (2013). A review and critical analysis of the principles of scientific management. *International Journal of Organizational Innovation (Online)*, *5*(4), 78.
29. Huang, S., Wang, B., Li, X., Zheng, P., Mourtzis, D., & Wang, L. (2022). Industry 5.0 and Society 5.0—Comparison, complementation and co-evolution. Journal of manufacturing systems, 64, 424-428. doi: 10.1016/j.jmsy.2022.07.010
30. Kass, L. R. (2003). Ageless bodies, happy souls: biotechnology and the pursuit of perfection. *The New Atlantis*, (1), 9-28.
31. Kehrig, M., & Vincent, N. (2021). The micro-level anatomy of the labor share decline. *The Quarterly Journal of Economics*, *136*(2), 1031-1087. doi: 10.1093/qje/qjab002
32. Kloutsiniotis, P. V., & Mihail, D. M. (2020). The effects of high performance work systems in employees' service-oriented OCB. *International Journal of Hospitality Management*, *90*, 102610. doi: 10.1016/j.ijhm.2020.102610
33. Koch, M., Manuylov, I., & Smolka, M. (2021). Robots and firms. *The Economic Journal*, *131*(638), 2553-2584. doi: 10.2139/ssrn.3377705
34. Lamovšek, A., & Černe, M. (2023). Past, present and future: A systematic multitechnique bibliometric review of the field of distributed work. *Information and Organization*, 100446. doi: 10.1016/j.infoandorg.2022.100446
35. La Torre, G., De Leonardis, V., & Chiappetta, M. (2020). Technostress: how does it affect the productivity and life of an individual? Results of an observational study. *Public Health*, *189*, 60-65. doi: 10.1016/j.puhe.2020.09.013

36. Lee, Y. L. A., Malik, A., Rosenberger III, P. J., & Sharma, P. (2020). Demystifying the differences in the impact of training and incentives on employee performance: mediating roles of trust and knowledge sharing. *Journal of Knowledge Management*, *24*(8), 1987-2006. doi: 10.1108/JKM-04-2020-0309
37. Letvak, S., & Buck, R. (2008). Factors influencing work productivity and intent to stay in nursing. *Nursing economic$*, *26*(3).
38. Li, J., Shan, Y., Tian, G., & Hao, X. (2020). Labor cost, government intervention, and corporate innovation: Evidence from China. *Journal of Corporate Finance*, *64*, 101668. doi: 10.1016/j.jcorpfin.2020.101668
39. Li, L., & Wang, X. (2021). Technostress inhibitors and creators and their impacts on university teachers' work performance in higher education. *Cognition, Technology & Work*, *23*, 315-330. doi: 10.1007/s10111-020-00625-0
40. Liao, Y., Loures, E. R., Deschamps, F., Brezinski, G., & Venâncio, A. (2017). The impact of the fourth industrial revolution: a cross-country/region comparison. *Production, 28*. doi: 10.1590/0103-6513.20180061
41. Martín-de Castro, G., Díez-Vial, I., & Delgado-Verde, M. (2019). Intellectual capital and the firm: evolution and research trends. *Journal of Intellectual Capital*. doi: 10.1108/JIC-12-2018-0221
42. Maruta, A. A., Banerjee, R., & Cavoli, T. (2020). Foreign aid, institutional quality and economic growth: Evidence from the developing world. *Economic Modelling*, *89*, 444-463. doi: 10.1016/j.econmod.2019.11.008
43. Matthes, J., Karsay, K., Schmuck, D., & Stevic, A. (2020). "Too much to handle": Impact of mobile social networking sites on information overload, depressive symptoms, and well-being, *Computers in Human Behavior*, 105, article 106217. doi: 10.1016/j.chb.2019.106217
44. Mayo, E. (1923). The irrational factor in human behavior: the" night-mind" in industry. *The Annals of the American Academy of Political and Social Science*, *110*(1), 117-130. doi: 10.1177/000271622311000112
45. Naoum, S. G. (2016). Factors influencing labor productivity on construction sites: A state-of-the-art literature review and a survey. *International journal of productivity and performance management*, *65*(3), 401-421. doi: 10.1108/IJPPM-03-2015-0045
46. Neuralink. *Neuralink's first human patient able to control mouse through thinking*. Pridobljeno 10. marca 2024 na: https://www.reuters.com/business/healthcare-pharmaceuticals/neuralinks-first-human-patient-able-control-mouse-through-thinking-musk-says-2024-02-20/
47. Obrenovic, B., Jianguo, D., Khudaykulov, A., & Khan, M. A. S. (2020). Work-family conflict impact on psychological safety and psychological well-being: A job performance model. *Frontiers in psychology*, *11*, 475. doi: 10.3389/fpsyg.2020.00475
48. Palvalin, M. (2019). What matters for knowledge work productivity?. *Employee Relations*, *41*(1), 209-227. doi: 10.1108/ER-04-2017-0091
49. Porter, A. (2017). Bioethics and transhumanism. *Journal of Medicine and Philosophy*, *42*(3), 237-260. doi: 10.1093/jmp/jhx001
50. Rai, S., & Rai, A. (2015). Nanotechnology-The secret of fifth industrial revolution and the future of next generation. *Nusantara Bioscience*, *7*(2). doi: 10.13057/nusbiosci/n070201
51. Ramos-Rodríguez, A. R., & Ruíz-Navarro, J. (2004). Changes in the intellectual structure of strategic management research: A bibliometric study of the Strategic Management Journal, 1980–2000. *Strategic management journal*, *25*(10), 981-1004. doi: 10.1002/smj.397
52. Ronda-Pupo, G., & Guerras-Martín, L. (2010). Dynamics of the scientific community network within the strategic management field through the Strategic Management Journal 1980–2009: the role of cooperation. *Scientometrics*, *85*(3), 821-848. doi: 10.1007/s11192-010-0287-4
53. Rosekind, M. R., Gregory, K. B., Mallis, M. M., Brandt, S. L., Seal, B., & Lerner, D. (2010). The cost of poor sleep: workplace productivity loss and associated costs. *Journal of*

Occupational and Environmental Medicine, *52*(1), 91-98. doi: 10.1097/JOM.0b013e3181c78c30
54. Rothman, B. S., Gupta, R. K., & McEvoy, M. D. (2017). Mobile Technology in the Perioperative Arena: Rapid Evolution and Future Disruption. *Anesthesia & Analgesia 124*(3), 807-818. doi: 10.1213/ANE.0000000000001858
55. Schwab, K. (2017). *The fourth industrial revolution*. Crown Currency.
56. Shekhar, S. S. (2019). Artificial intelligence in automation. *Artificial Intelligence*, *3085*(06), 14-17.
57. Shirish, A., Chandra, S., & Srivastava, S. C. (2021). Switching to online learning during COVID-19: Theorizing the role of IT mindfulness and techno eustress for facilitating productivity and creativity in student learning. *International Journal of Information Management*, *61*, 102394. doi: 10.1016/j.ijinfomgt.2021.102394
58. Spektor, F., & Fox, S. (2020). The 'working body': interrogating and reimagining the productivist impulses of transhumanism through crip-centered speculative design. *Somatechnics*, *10*(3), 327-354. doi: 10.3366/soma.2020.0326
59. Taneja, S., Pryor, M. G., & Toombs, L. A. (2011). Frederick W. Taylor's scientific management principles: Relevance and validity. *Journal of Applied Management and Entrepreneurship*, *16*(3), 60.
60. Taylor, F. W. (2004). *Scientific management*. Routledge.
61. Tirosh-Samuelson, H. (2012). Transhumanism as a secularist faith. *Zygon®*, *47*(4), 710-734. doi: 10.1111/j.1467-9744.2012.01288.x
62. Thompson, J. (2017). Transhumanism: How Far Is Too Far?, *The New Bioethics, 23*(2), 165-182. doi: 10.1080/20502877.2017.1345092
63. Troth, A. C., & Guest, D. E. (2020). The case for psychology in human resource management research. *Human Resource Management Journal*, *30*(1), 34-48. doi: 10.1111/1748-8583.12237
64. Upadhyaya, P., & Vrinda. (2021). Impact of technostress on academic productivity of university students. *Education and Information Technologies*, *26*, 1647-1664. doi: 10.1007/s10639-020-10319-9
65. Watson, D. (2019). Fordism: A review essay. *Labor History*, *60*(2), 144-159. doi: 10.1080/0023656X.2019.1537031
66. Zhang, Q., & Ma, Y. (2021). The impact of environmental management on firm economic performance: The mediating effect of green innovation and the moderating effect of environmental leadership. *Journal of Cleaner Production*, *292*, 126057. doi: 10.1016/j.jclepro.2021.126057
67. Zhao, D., & Strotmann, A. (2008). Evolution of research activities and intellectual influences in information science 1996–2005: Introducing author bibliographic-coupling analysis. *Journal of the American Society for Information Science and Technology*, *59*(13), 2070-2086. doi: 10.1002/asi.20910
68. Zhao, X., Xia, Q., & Huang, W. (2020). Impact of technostress on productivity from the theoretical perspective of appraisal and coping processes. *Information & Management*, *57*(8), 103265. doi: 10.1016/j.im.2020.103265
69. Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational research methods*, *18*(3), 429-472. doi: 10.1177/1094428114562629

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Abstract:
Productivity through the Lens of Bibliometric Analysis

Background and Originality: The study focuses on analysing the development of the concept of 'labour productivity', which has emerged as a fundamental concept in the field of business economics over the past 90 years. It is the first study of its kind to encompass such a large scale of scientific articles.
Method: The authors employed bibliometric analysis, specifically co-occurrence and coupling analysis. They analysed 13,575 articles from the Web of Science database.
Results: The study identified paradigm shifts and intellectual developments in the field of labour productivity and contemplated possible directions for future research. The most likely direction highlighted was the connection between the concept of labour productivity and the idea of transhumanism, which aims to merge humans with innovations in artificial intelligence.
Society: The study's results compel a re-evaluation of the potential dangers suggested by trends in human-technology integration.
Limitations / further research: Future research could analyse more keywords that conceptually fall within the scope of labour productivity and could utilize other databases.

Keywords: economics, productivity, labour, transhumanism.

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The Project Triangle Paradigm

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Abstract:

Background and Originality: The project triangle, also named the triple constraint, iron triangle, golden triangle, and agile triangle, is a central concept in project management research and practice that represents the relationship between key performance measures. However, there is disagreement about which criteria should be represented at the vertices of this triangle.

Purpose: The purpose of this paper is to explore which concepts are part of the project triangle and how these concepts have changed over time. Our purpose is to conduct a systematic review of scientific articles dealing with the topic of the project triangle and its elements (time, cost, and scope). We want to demonstrate that there is a theoretical gap in the classical theory of the project triangle and that the elements of the project triangle are ultimately reflected in successful project management. Addressing this topic will contribute to eliminating or at least reducing the perceived theoretical research gap, or confusion regarding the positioning of the elements of the project triangle and the connection of these elements to the success of projects.

Method: A systematic review of the scientific literature will be conducted using publicly available databases, namely "iron triangle", "triple constraint", "project performance" and "success factors" as search terms. Scientific articles and doctoral/master's theses were searched in the databases Academia.edu, ProQuest, ScienceDirect, Elsevier/Scopus and Google Scholar. We excluded literature that does not directly relate to the field of research.

Results: We found out that there is a gap in the basic theory of the project triangle or to be more exact confusion about the positioning of quality and scope of the project in the project triangle. We therefore want to reduce the gap and confirm the thesis that quality is not one of the 3 elements of the project triangle but is indirectly defined through the elements of the project triangle (time, cost, scope). The authors of the research carried out so far listed the elements of the project triangle and defined success criteria of the projects by group, among which the individual elements of the project triangle were classified. We expect to confirm the hypothesis that there is a connection between the elements of the project triangle and success of projects.

Society: Our research will confirm the dimensions of the project triangle concept and show the influence of its elements on the most common groups of success criteria, with the help of which companies measure the success of projects. This research will show which elements of the project triangle and criteria are given greater importance by the scientific literature, which represents a starting point for optimization in the field of managing various types of projects.

Originality: Understanding the concept of the project triangle and its role in the creation of success criteria will help the various stakeholders involved in project management to be more motivated to monitor the elements of the project triangle and that this will allow them to manage more effectively, which in turn also affects their commitment in performing project duties.

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Limitations / further research: The topic under discussion has been well studied for the past 20 years, although it has undergone a great deal of theoretical transformation. At the same time, we note that the theoretical treatment is not followed by scientific research, as it mainly covers the field of methodology, factors and strategies for the success of project management in the construction industry or on large investment projects, in the field of IT and healthcare. Proposals for further research will be made to conduct research on this topic in other industries and on other types of projects and on several different stakeholders and/or stakeholder groups involved in project management.

Keywords: project management, project triangle, triple constraint, iron triangle, agile triangle, project performance, success factors

1 Introduction

The concept of the project triangle appears in the foundation of project management theory as a basic model that is helpful in determining the constraints of a project and in defining its success, but the terminology of the project triangle is inconsistently used. With the development of project management and different methodologies for defining success, other concepts appear that replace the project triangle, namely the triple constraint, the iron triangle, the golden triangle and the agile triangle, all of which define the central concept of project management research and practice. The project triangle consists of three elements at the vertices, which represent the relationship between the key performance criteria, which is why some authors also call the project triangle a triple constraint, as these three vertices of the triangle are supposed to outline the boundaries and define the essence of each project. Thus, in the academic world, throughout various periods until today, there is disagreement among authors about which elements should be presented at the vertices or on the sides of this triangle.

A systematic review of the theory of the project triangle for the period between 2002 and 2021 was carried out by Egboga & Cross (2022), based on the existing literature. They used the so-called Systematic Quantitative Assessment Technique (SQAT) and found that the iron triangle components of time, cost, and scope are still relevant performance measures for construction projects (p. 4). They analyzed 45 published articles, conference papers, and book chapters. They combined the results into nine (9) performance measures in chronological order, including time, cost, and scope, as the basic components of the project triangle, for which they used the term iron triangle. The topic of the project triangle has been well studied for the last 20 years, although it has undergone a lot of theoretical transformation. At the same time, we note that the theoretical treatment is not followed by scientific research, as it mainly covers the field of methodology, factors, and strategies for the success of project management in the construction industry or on large investment projects, in the field of IT and healthcare. Due to the above, we included in our research only scientific research contributions from

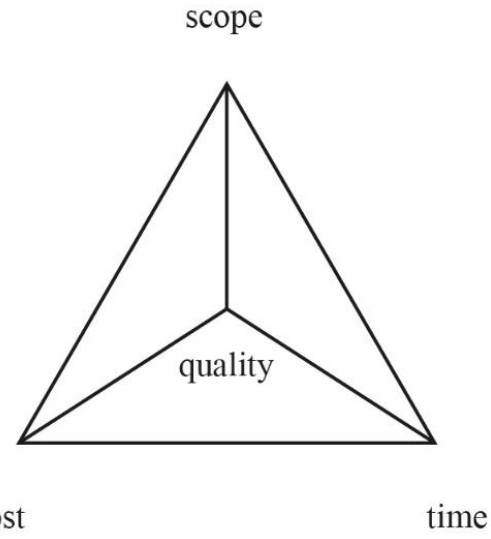
the period from 2021 to 2024. With this, we continued the continuity of the review of the theory of the project triangle and tried to find deviations from what had already been carried out. The purpose of this paper is to investigate which theories or concepts of the project triangle exist and which criteria appear in the vertices of the project triangle in the period of the last 3 years.

2 Theoretical Framework

2.1 The Traditional Project Triangle

The project management triangle consists of three variables that determine project quality: scope, time, and cost (Highsmith, 2009). The traditional project triangle, as shown in Figure 1, illustrates how these three variables are interrelated. At the same time, the rule applies that if one of the variables changes, the other two variables must be adjusted to keep the triangle connected or in balance. In the case one point or a vertex of the triangle moves without adjusting one and/or both of the other vertices, the quality of the project deteriorates. We refer to this as a triangle breakdown. Therefore, a key goal of project management and consequently project stakeholders is that all three elements of the project are balanced, which means that the project is kept within the budget and deadline and meets the essential characteristics regarding the scope of the project (Team Asana, 2024).

Figure 1
Traditional project triangle or iron triangle



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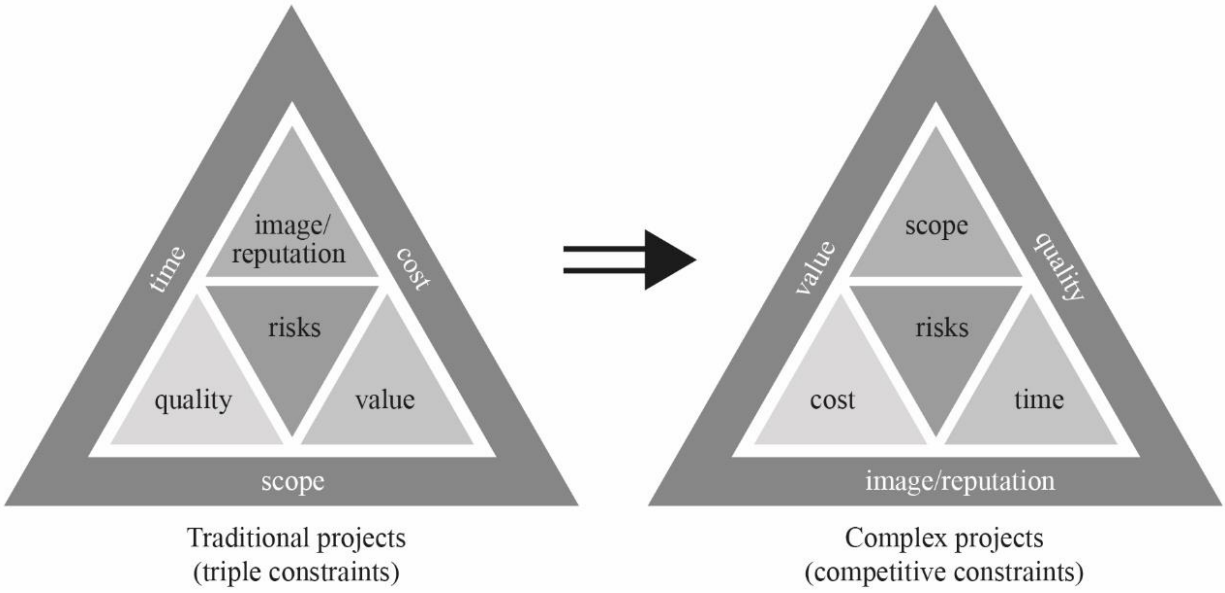
2.2 The Traditional Project Triangle Paradigm

The traditional project triangle paradigm begins with its three constraints. Kerzner (2023, p. 25) states that the triple constraint can be defined as a triangle with three sides representing time, cost, and capacity, and capacity itself should include quality, scope, and technical capability. He goes on to say that nowadays project managers have realized that a project has several constraints, which he calls competitive constraints (p. 29). For more complex projects, the success factors of the traditional triple constraint are constantly changing.

For traditional projects, time, cost, and scope are higher priorities than constraints within the triangle (Kerzner, 2023, p. 23) and as shown in Figure 2, image/reputation, quality, value, and risk are less important. But for more complex projects, constraints within the triangle are more important, so the term the triple constraint is abandoned in recognition of the fact that the exact number of constraints that define project success and their relative importance may vary from project to project. A constraint twist occurs when the traditional triple constraints take a place within the project triangle, and project image/reputation, quality, and value come to the fore with higher priority. It is important to define a metric for each constraint in the project, but it cannot be realistically expected that all constraint metrics will also be considered as key performance indicators of the project.

Figure 2
From triple to competitive constraints

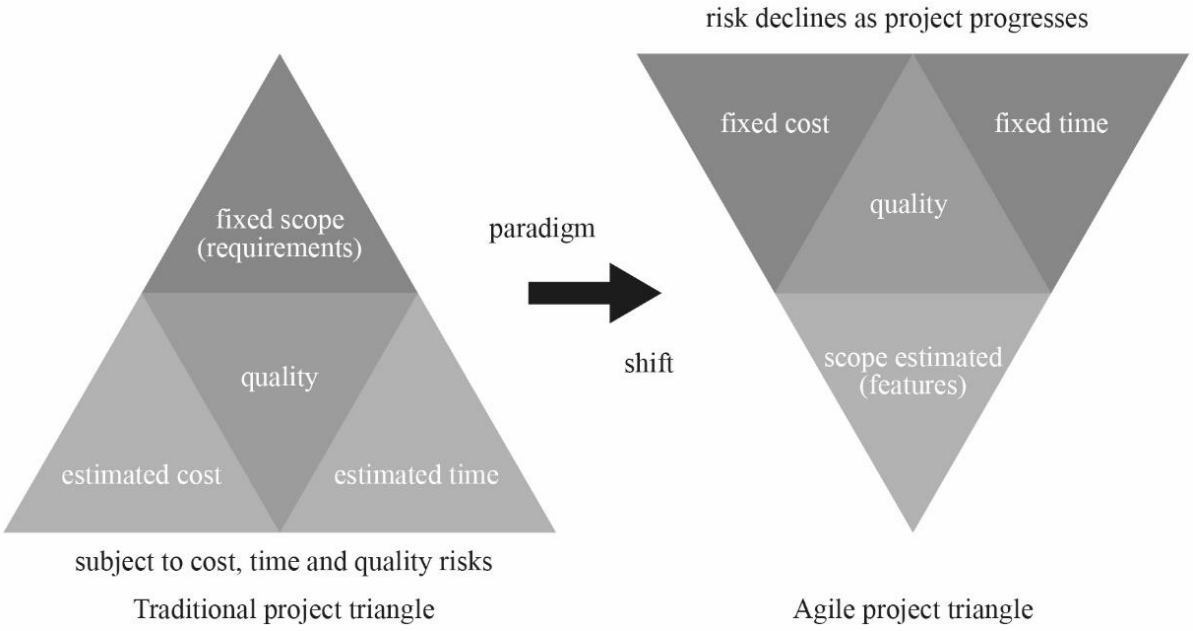


Note. Reprinted from "Project Management Metrics, KPIs, and Dashboards. A Guide to Measuring and Monitoring Project Performance" by H. Kerzner, 2023, Hoboken, New Jersey: John Wiley&Sons,4th ed., p. 29, Copyright 2023 by John Wiley&Sons. Reprinted with permission.

2.3 The Agile Project Triangle

The first paradigm of the project triangle occurs, as shown in Figure 3, when the traditional waterfall triangle is turned upside down (Vertical motion). This most often happens in IT projects, where time and cost are used as fixed constraints, and only the scope changes. This upside-down traditional triangle still fits the dimensions of the project triangle, as project success is still reflected in compliance with cost, time, and scope, but the shape is not stable. The format is only temporary because it does not reflect the essence of true agile projects, which are constantly adapting and therefore cannot be considered successful by traditional standards because they can never be completely consistent with the plan.

Figure 3
Traditional and Agile Iron Triangle



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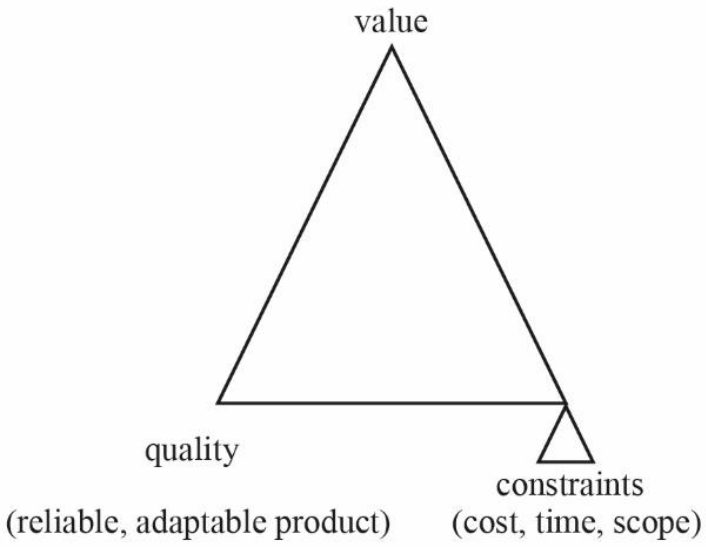
The flexible agile triangle (see Figure 4) derives only in form from the traditional project triangle, which still puts three criteria in the foreground, namely value (for project stakeholders), quality, which ensures the reliability and adaptability of the product in the eyes of the user, and three traditional constraints (time, cost and scope) of the project (Highsmith, 2009). Constraints are still important parameters of the project, but they do not represent the main goal of the project. The primary goal of the project is stakeholder value, and constraints are adjusted as the project evolves and stakeholder value increases. Time still remains a fixed constraint, and we can adjust the range to provide the highest value within the available time.

Figure 4
The Agile Triangle



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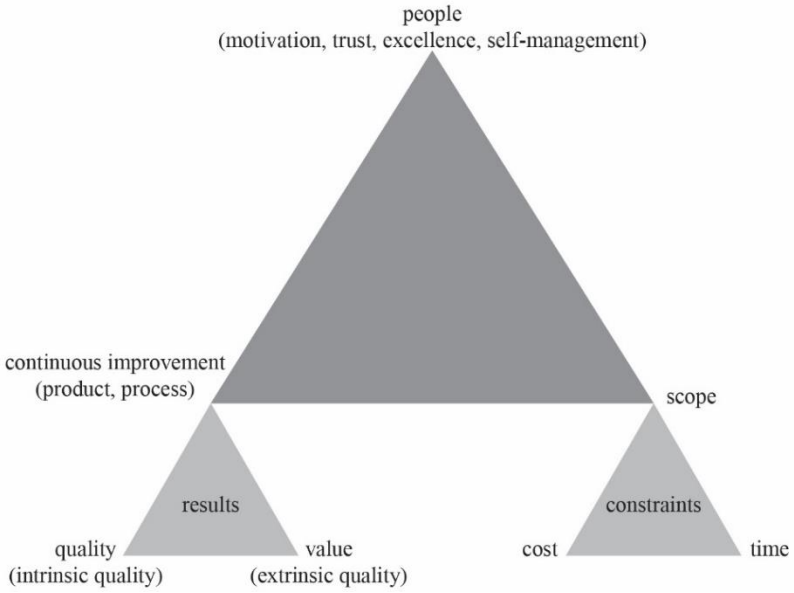
Salazar (2018), among other things in software development projects, emphasizes that improving the quality of products and increasing the value that these products provide to users is a continuous process that brings the user to the next level of optimization, satisfaction and happiness. The author understands this agile triangle model as an extended agile triangle (see Figure 5). The most important factor in any agile project is therefore the people who intervene in the project through personal communication and individual motivation. With constant attention paid to technical excellence, self-management of the project team and the organization's trust in themselves, all this is the basis for the success of the project, for the creation of new services and products, and for the continuous improvement of the project's processes and products.

Figure 5.
The Concept of the Extended Agile Triangle



Note. Reprinted from "From iron triangle to agile triangle (extended)" by L. Salazar, 2018. Copyright 2018 by L. Salazar. Reprinted with permission.

2.4 The Sustainable Project Triangle

Modifications of the project triangle have evolved over the decades. Among others, Pollack, Helm & Adler (2018, pp. 544-545) state that scope, capacity, requirements, and quality could be used interchangeably in the third vertex of the project triangle. The third vertex is therefore of varying importance depending on the type of project being evaluated. But there are also new versions of tools that contain six pillars and triangles with a third dimension, in which softer and less measurable aspects are present, e.g. value for the project team, for the user, etc.

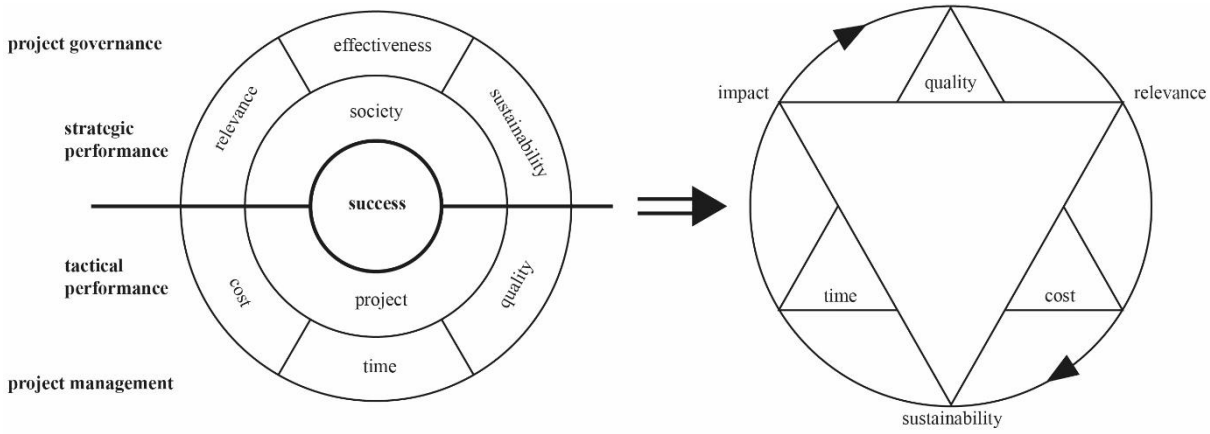
Samset & Volden (2016a) argue:

> Success in a tactical sense usually means meeting short-term performance goals, such as producing agreed-upon results on time and within budget. This is an essential issue of project management. Strategic performance, on the other hand, involves broader and longer-term considerations about whether the project will have a sustainable impact and remain relevant and effective during the implementation phase and throughout its lifetime. This is essentially a question of correctly defining the business case, or in short choosing the most viable project concept. (p. 300)

The concept of successful projects, as shown in Figure 6, is adapted by Samset & Volden (2016b, p. 4) and Madsen (2013). In the concept of successful projects Samset & Volden

(2016, p. 4) emphasize the strategic performance and tactical performance as the key to a successful project, if we want the project to be successful from the perspective of society as well. On the other hand, Madsen (2013) simplified the concept of successful project in the form of a star with six key pillars, namely the first triangle shows the traditional constraints of the project (time, cost and quality), while the second triangle is inverted and resembles agile values with three constraints (impact, relevance and sustainability of the project).

Figure 6.
The Sustainability Project Triangle



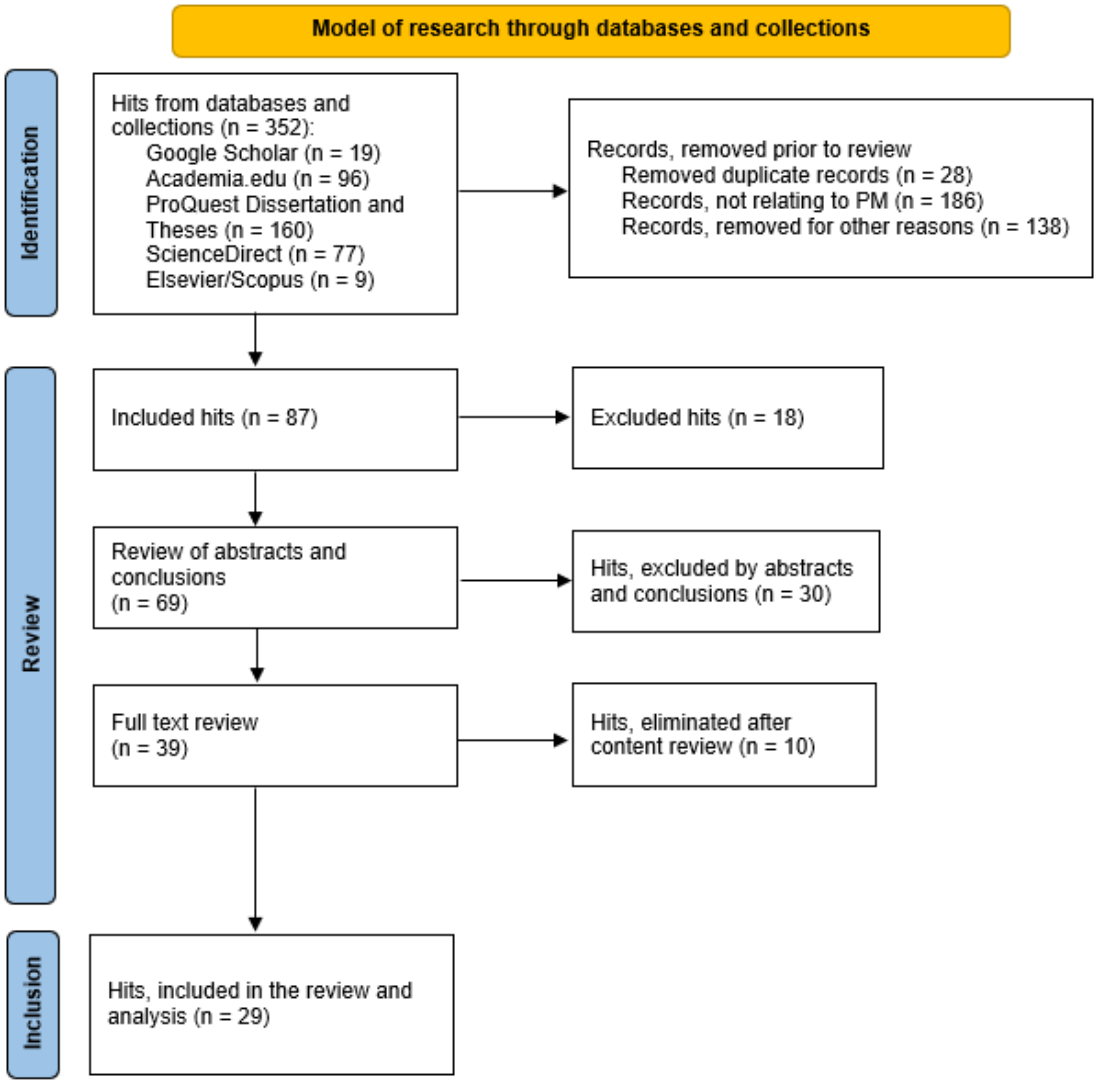
Note. Adapted from "Front-end Definition of Major Public Projects. Theoretical insights and conflicting practices" by K. F. Samset and G. H. Volden, 2016b, A selection of findings from studies conducted by the Concept Research Program. Norwegian University of Science and Technology, Trondheim, p. 4 and from "Is the iron triangle outdated?" by S. Madsen, 2013. Copyright 2016b by K. F. Samset and 2013 by S. Madsen. Reprinted with permission.

3 Method

We searched for scientific research articles and dissertations in the Academia.edu, ProQuest, ScienceDirect, Elsevier/Scopus and Google Scholar databases using the search terms "trojna omejitev" OR "železni trikotnik" AND "uspešnost projekta" OR "dejavniki uspeha" in Slovenian language and "triple constraint" OR "iron triangle" AND "project success" OR "success factors" in English. In the repositories of the University of Ljubljana, the University of Maribor, the University of Primorska and the University of Nova Gorica, we searched for scientific works from the Slovenian area in the period 2021-2024, but we did not find any results. We used Mendeley reference management software to archive scientific works and created our database for analysis in Microsoft Excel. We selected scientific works in such a way that we eliminated duplicates of individual scientific works and those works that did not directly relate to the field of research, i.e. to the project triangle and the success of the project. Works that were not written in English or Slovenian and works dated before 2020 were excluded. We wanted to check whether

the paradigm of the so-called "iron triangle" continues even after 2020, as we found that transparent scientific articles on the discussed topic were written and included the year 2020 as the final year of the period under consideration. In the following, we also selected the scientific papers according to the read abstracts and focused on the papers that, in addition to the relevance of the search parameters, also included empirical research. The research model and the process of selecting relevant scientific research papers for a systematic review of the literature (see Figure 7), which is related to the research question, is shown with the so-called PRISMA diagram based on Page et al. (2021).

Figure 7.
Model of research through databases and collections



After reading the summaries and conclusions of the scientific papers found with the above-mentioned search method, we additionally selected the scientific papers and at the same time ensured that they dealt with the iron triangle or the triple constraints and the success of projects or the success factors of projects. The exclusion criteria were that

the paper was not written in English or Slovenian, we also excluded papers that were purely theoretical and did not include empirical research and studies, and scientific research papers from non-engineering activities, such as e.g. health services, education, tourist services, etc. The inclusion criterion was that the contribution contains at least one constraint that appears in the theory of project constraints according to the project triangle model, i.e. time, cost, scope, or quality constraints, and at the same time has a content connection to project success or project success factors. Only after the additional selection was completed did we start reading the full texts of the contributions. Thus, 29 scientific research works were included in the final review.

4 Results

After reviewing the theoretical starting points and various models that are used to illustrate the project constraints that determine the essence of the project, we found that there is a gap in the basic theory of the project triangle. confusion about positioning project quality and scope in the project triangle model. By reviewing scientific research works after 2020, we want to confirm the continuation of the so-called paradigm. of the "iron triangle" and at the same time reduce the gap and confirm the thesis that quality is not one of the 3 limitations of the project triangle but is indirectly defined through the traditional limitations of the project triangle (time, cost, scope).

The results show that there is no consistent correlation as to what performance is and that the traditional constraints shown by the cost-time-quality project triangle model are still the most appropriate method for performance analysis. Mellado, Lou & Becerra (2020) also claim this and add that this is the reason for the existence and relevance of the term "iron triangle", even though such a model has proven to be ineffective.

In the research, we considered 69 relevant scientific articles with empirical research and/or dissertations (see Table 1), which were obtained by selecting scientific research contributions (hereinafter also "SR") from databases.

Table 1
Relevant scientific research papers included in the research

Journal/Database	Number of SR contributions	Relevant	Applied	The proportion of applied
Google Scholar	19	5	5	26%
Academia.edu	96	27	7	7%
ProQuest Dissertations & Thesis	160	19	7	4 %
ScienceDirect	77	11	5	6 %
Elsevier/Scopus	9	7	5	56%
RUL	0	0	0	0
RUP	0	0	0	0
RUNG	0	0	0	0
DKUM	0	0	0	0
TOTAL	361	69	29	8 %

The scientific research papers included in our research were from the period 2021 to 2023, with 2 hits from ScienceDirect published in early 2024 also being relevant. Table 2 also shows that the topic is still topical, as the number of relevant publications on the discussed topic is represented in each individual year of the period 2021-2024.

Table 2
The number of relevant scientific research papers on the discussed topic

Journal/Database	2021	2022	2023	2024
Google Scholar	2	3	0	0
Academia.edu	11	14	2	0
ProQuest Dissertations and Theses	7	10	2	0
ScienceDirect	2	1	6	2
Elsevier/Scopus	2	3	2	0
TOTAL	24	31	12	2

Through the review of the literature, five (5) important project constraints (the authors also understand them as project "criteria"), as used by various authors in their research, were identified, and we marked them in columns A to E, where: A = time; B = cost; C = scope; D = quality and E = other. Under column E = other, other limitations that appear in the project triangle (e.g. satisfaction, benefits, safety, sustainability, etc.) are defined individually as specifics of the individual author. Column F = project success, with concrete indicators by individual authors in the continuation of the research. Column G lists the method used by the individual author to obtain the data and H the country and/or economic activity where the research was conducted. The use of "x" in the individual box of Table 3 means that the author used or stated in his scientific contribution a certain element and/or connected it to the success of the project.

Table 3
Empirical research indicating the constraints of the project triangle

			Constraints of the project triangle							
No.	Author(s)	Year	A	B	C	D	E	F	G	H
1	Al Mokhtar et al.	2021	x	x	x		x	x	Questionnaire	Saudi Arabia, construction
2	Clark	2021	x	x	x		x	x	Questionnaire (certified PMP)	USA
3	Essien	2021	x	x		x	x	x	Questionnaire and interview	Nigeria, construction
4	Hailemichael	2021	x	x		x	x	x	Questionnaire and interview	Ethiopia, construction
5	Hussain et al.	2021	x	x	x	x		x	Questionnaire	construction
6	Jayyousi	2021	x	x		x	x	x	Questionnaire	UAE, construction
7	Vrchota et al.	2021	x	x	x	x	x	x	Survey of manufacturing companies	Czech Republic, high-tech manufacturing companies
8	Shrestha	2021	x	x		x		x	Questionnaire and interview	mining sector, capital and industrial projects
9	Ajibike et. al.	2022	x	x		x	x	x	Questionnaire	Malaysia, oil and gas industry

»se nadaljuje«

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10	Alade et al	2022	x	x		x	x	x	Interview, observations, secondary data	Ethiopia, light rail transport projects
11	Amora & Juanzon	2022	x	x	x	x	x	x	Questionnaire	Philippines, construction
12	Bond	2022	x	x	x				Interview (certified PMP)	UAE, international development projects
13	Bukoye et al.	2022	x	x		x	x	x	Semi-structured interview, secondary data sources	large-scale projects of different sectors
14	Borsuk	2022	x	x		x	x	x	Virtual interview, questionnaire	USA, industry of medical devices & equipment industry
15	Bursaw	2022	x	x	x	x	x	x	Questionnaire	USA, non-IT environment
16	Byers	2022	x	x	x		x	x	Questionnaire and interview	Australia, construction
17	Cardella	2022				x	x	x	Questionnaire	USA, different types of industry
18	Hussain et al.	2022	x	x		x	x	x	Survey questionnaire	Pakistan, construction
19	Ika et al.	2022	x	x	x	x	x	x	Literature review	IJPM
20	Imran et al.	2022	x	x		x	x	x	Structured questionnaire	Bangladesh, construction
21	Lama et al.	2022	x	x		x	x	x	Questionnaire	Nepal, construction
22	Sidlayiya	2022	x	x	x	x	x	x	Questionnaire, case study	SAR, event industry
23	Varajão et al.	2022	x	x	x		x		Literature review (34 articles, 13 IT and 21 non-IT)	IT
24	Volden et al.	2022	x	x		x	x	x	Subsequent evaluation of investment projects	Norway, public investment projects
25	Yedvav et al.	2022	x	x		x	x	x	Interview	Israel, defense industry
26	Adejoh et al.	2023	x	x		x		x	Survey questionnaire	Norway, public investment projects
27	Kumar et al.	2023	x	x	x	x	x	x	Semi-structured interview	construction
28	Locatelli et al.	2023	x	x	x	x	x	x	Literature review and review of cases	Italy, infrastructure projects
29	Moreno-Monsalve et al.	2023	x	x	x		x	x	Structured survey	Columbia, technology sector, infrastructure and services

A = time
B = cost
C = scope
D = quality
E = other
F = project success

The authors of the research carried out so far stated the constraints according to the project triangle model and in different ways tried to meaningfully form the groups of factors, indicators, criteria, etc., that define a successful project.

5 Discussion

Traditional activities such as construction, large engineering investment projects, etc., still define the project using the triple constraint according to the project triangle model.

This is confirmed by an extensive study conducted in the Saudi Arabian construction industry by Al Mokhtar et al. (2021), in which it was established that project managers should not exceed project constraints (scope, budget, and timeline). The specifics of these authors is transformational leadership, which the authors claim positively influences progress and helps project managers ensure project success. Among the factors of transformational leadership, three essential components were highlighted: idealized influence, intellectual stimulation, and individual treatment, which significantly influence success, while the so-called motivation with inspiration does not affect the success of the project.

Our claim is partially confirmed through the findings of a study conducted in 114 high-tech manufacturing companies in the Czech Republic, in which Vrhota et al. (2022, pp. 9-11) pointed out that larger companies focus more on planning (time constraints) and quality, while companies with fewer employees focus more on communication, employees, and leadership.

Girma (2021, pp. 26-27) mentions “social and environmental issues” as a special element of the project triangle, which should appear in 2% of the results of her research, while the traditional project constraints costs have 88% representation, time 85 % and a quality of 98% representation, which undoubtedly confirms our claim about the importance of triple constraints. Among other things, the author connects the success of the project with physical work and financial status, all of which should also be reflected in the performance indicators.

In a study in a non-IT environment, Bursaw (2022, p. 67) confirmed through interviews the hypothesis that projects are associated with a triple constraint in terms of time, scope, and cost, that the triple constraints operate independently but can overlap and thus wrap the project in a spiral. Through interviews, in her study, Bond (2022, p. 79) also found that project managers use more innovative and creative project management strategies to reduce the negative impact of the triple constraints (cost, time, and scope) of international development projects, which increase business profitability and contribute to a healthier and safer working environment. These strategies are scope management, stakeholder management, and project management planning.

Project constraints according to the project triangle model give traditional industries a solid foundation on which to build a successful project. This is the reason why the term "iron triangle" also appears in the literature, which various authors associate with project success criteria. In a study of project competencies and success, Clark (2021, p. 49) used a standard project management model in which a successful project is defined as a

project that is completed within schedule, cost, and scope (the triple constraint) and executed against how stakeholders perceive communication, engagement, and sustainability. He showed that competencies in the field of project management improve the success of the project. The term "iron triangle" or "golden triangle" was traced to Yedvav et al. (2022, p. 9-10), who associate both terms with the success of the project, or with focusing on time, budget, and quality constraints. Their study examined and analyzed the implications and effects of deviations in project limits on defense projects.

Also, Varajão et al (2022, pp. 483-484) emphasizes customer satisfaction as one of the criteria of the project triangle, with the other vertices being occupied by "time-cost-conformity to scope". Sidlayiya (2022) and Varajão's et al. (2022) focus on customer satisfaction or client expectations is so much more interesting, as the first (Sidlayiya, 2022) conducted the study on the example of the event industry, while the second (Varajão et al., 2022) conducted a literature review in the field of information technology (hereafter "IT"), although he included 21 non-IT articles in the survey of 34 articles.

In a study of the impact of contractor selection criteria on critical success factors of public projects in Nigeria, conducted by Adejoh et al. (2023, p. 96), it was pointed out that for the effective implementation of public projects, it is necessary to respect costs, time and quality (the triple constraint of the project), and it is very important to carefully consider all the criteria and factors for selection of the contractor, as each project has its characteristics and peculiarities.

Ika et al. (2022, pp. 835-848) propose a four-dimensional project performance model that includes eight (8) combinations of the first three dimensions: project plan, business case, and green success, and propose four multidimensional sources of project success, among which the newly recognized green performance and an emphasized sharing of stakeholders' feelings. In examining the determinants of risk factors on project success of construction companies in Bangladesh, Imran et al. (2022, p. 995-996) confirmed that risk management and financial risk play an important role in the success of any project in the construction industry, while technical and environmental risks do not affect the success of the project. Among other things, they identified risk factors and their impact on the success of the project in terms of cost, time, and quality (the so-called triple project constraints) and environmental sustainability security.

In the mining sector, a study was conducted in which Shrestha (2021, pp. 181 and 210) confirmed with statistical data that the industry can improve cost and time efficiency by achieving several critical success factors, i.e. CSFs, whereby he included cost efficiency (according to the project triangle model, this is a cost project constraint), agility,

predictability, safety, quality (indirect project constraint), schedule (project time constraint according to the project triangle model), management of changes (project constraint of scope), environmental goals and sustainability, but the identified goals as statistically significant are safety, change management and environmental goals.

In a study of 36 large construction projects from the public and private sectors, Hussain and co-authors identified quality as a third constraint and defined it as “the fulfillment of agreed project requirements” (2021, p. 9), thus focusing on defining quality as a constraint on project requirements in accordance with the contract agreed upon by the interested parties. As a composite measure of project success, it states in the same place that it is necessary to continuously look at whether the project was or is on time, cost, and scope/quality. Through a study conducted in the construction industry in the Philippines, Amora and Juanzon (2022, p. 272) determined 26 critical success factors (CSFs) and 5 most recognizable success criteria (SCs), which also appear most frequently in the existing literature, namely satisfaction customers, costs (budget), time (timetable), quality (implementation) and satisfaction of other stakeholders. Based on the prioritized CSFs and recognized SCs, they have developed a framework that can be used by construction project participants and can serve as a guide to achieving the ultimate goal of all construction projects, which is success. The average success of each project in the study of the Nepalese construction industry by Lama et al. (2022, pp. 1890-1900) defined time, quality, and budget, i.e., a triple project constraint, extending project success to market and customer requirements. Namely, they determined that average project success is one of the 4 dimensions of successful multi-project management. The other 3 dimensions are a strategic fit, balanced portfolio, and future potential.

During the review of SR, we detected a research gap in the positioning of quality or scope in the third vertex of the project triangle model, and this positioning gap needs to be explained. Essien (2021, p. 32) recognizes "time-cost-quality" as a constraint of the project triangle but emphasizes that projects are embedded in complex systems that have internal and external dimensions. Therefore, he found a solution in the creation of 21 project performance indicators, which also include criteria derived from project constraints of costs, time, and quality, as well as stakeholder satisfaction (2021, p. 33), which appear in projects on several levels. In the following, Essien claims that due to the involvement of various project stakeholders, it is necessary to clearly define the goals of the project and to understand the difference between the success of the project and the success of project management. It is necessary to connect both performances with the general organizational goal so that the performance of the project begins to be viewed from both operational and strategic perspectives (p. 31).

Sidlayiya (2022) and Byers (2022) have a somewhat different view of the constraints of the project triangle. Byers (2022, p. 226) places the scope of the project instead of quality in the vertices as criteria of the project triangle and defines an additional, fourth element of stakeholder satisfaction, recognizing 9 factors of project success. Young turns the project triangle into a diamond shape (cited in Sidlayiya, 2022, p. 4), so Sidlayiya states "cost-time-quality-scope" as a four-fold constraint, while client expectations must not be neglected, so he defines NPS as a performance indicator (Net Promoter Score), which is reflected through customer loyalty or satisfaction (pp. 25-26). Also, Bukoye et al. (2022, pp. 893-897), using interviews and secondary data sources from government and industry reports, identified 21 tools that directly and indirectly promote three (3) key project performance measures – time, cost, and quality. Project quality was defined by Burshaw (2022, p. 68) as the expectation of stakeholders. Namely, it argues that key project knowledge is exchanged between project teams during active project implementation through quality-focused collaboration, collaborative techniques, and crosstalk.

Among all the reviewed studies, Cardella (2022, p. 52) focused on studying the impact of quality on organizational learning and project management success. He found that the quality of project completion has a significant impact on organizational learning (p. 78). Somewhat surprising is the statistical insignificance of the mild effect of project completion quality between project organizational capacity and project management success (pp. 80 and 86). From his findings, we can conclude that quality is not a project constraint, but rather the added value of project constraints, which is reflected in the success of the project.

The links between project constraints and project performance measures can be direct or indirect. In the previously mentioned study, Vrhota et al. (2022, pp. 7-13) realized that human resources in project management, plans and deadlines (i.e. time as a project constraint), and quality are success factors, and among these, soft factors are those that are essential for the success of projects. The authors did not investigate whether the links between project time constraints and success are direct or indirect.

Project success is also defined by triple constraints in Ajibike et al. (2022, p. 50), namely with time, cost and quality, where the authors in the study investigated the effect of internal risk factors and government support on the projects of oil and gas companies. They found that all exogenous factors, such as risk planning, risk management, financial risk, and material risk factors, as well as state support, have a significant impact on the success of the project (p. 47). As key performance indicators of the light rail transport project in Ethiopia, Alade et al. (2022, p. 419) highlight price and infrastructure as a recognized advantage of the project, examining the influence of the selection of

architects on cooperation with four key international organizations. This studied impact therefore represents an indirect link to the success of the project.

Research in 4 manufacturing companies of medical devices and industrial equipment conducted by Borsuk (2022, p. 70) confirmed that companies that used agile project methodology had more precisely defined implementation factors that had a positive impact on project success. In his doctoral study, Jayyousi (2021) demonstrated that it is necessary to consider new concepts of project success, as following the framework of triple project constraints is not enough.

In examining the effects of activity planning, time management, human resource management, and tasks on project success in the construction industry in Pakistan, Hussain et al. (2022, pp. 74-76) found that all four factors of project management have a significant impact on project success, with activity planning (project constraint of time) contributing the most to project success. Stakeholders and their satisfaction are key factors influencing the success of the project, but there are several different project stakeholders and each of them has a unique perception of both, the constraints that determine the project and the success of the project itself.

In Norway, an ex-post evaluation of four public investment projects was undertaken and Volden and Welde. (2022, pp. 711-712) found that public projects are often more successful than the public thinks, highlighting the role of the media as the main source of information, which defines success too narrowly or is too negatively biased. Therefore, the authors emphasize three levels of project success, namely operational success (shown by the product, and project outcome and measured by evaluating effectiveness), tactical success (has an effect on individual groups of users, and therefore is measured by the effectiveness of achieving their goals) and strategic success, which has a direct impact on society and is measured by sustainability, relevance, weighing between benefits and costs and other impacts (p. 706).

Our findings regarding stakeholders are also supported by the concept based on business value for the user/customer as proposed by Jayyousi (2021). In this concept, both parties are satisfied - contractors or construction companies and customers or users. The author also confirmed the hypothesis that the use of a transformational approach to construction project management increases the project's compliance with the specifications of the triple project constraints concept (pp. 85-91).

Moreno-Monsalve et al. (2023, p. 11) in their study of sustainable development and value creation focused on the aspect of project management and concluded that a successful

project must always be sustainable and create high value. In the sample of selected companies, it was observed that sustainable projects focused on creating organizational value are more successful than those projects focused on task development. This finding is important because it allows us to break the focus of mechanical control and place project management in a transversal plane that consists of three dimensions: organizational, human, and engineering. The importance of stakeholders in defining projects as successful was also emphasized by Kumar et al. (2023, p. 11) in a study of construction projects, where they pointed out that the traditional constraints of the "iron triangle" are important but considered insufficient in defining project success. Project professionals are increasingly relying on other indicators of project performance, as construction projects are complex, requiring consideration of many stakeholders, complex work systems/tools, and complex communications, as well as uncertainty.

6 Conclusion

As we previously stated, during the SR review, we detected a research gap in the positioning of quality or scope in the third vertex of the project triangle model, since among the 29 studied scientific works that we included in the qualitative synthesis of the period of the last 3 years, only eight SR works covered all the constraints that appear in the traditional project triangle (time, cost, scope and quality). The majority of authors (21 out of 29) still chose between scope and quality as the third constraint of the project triangle model, with 15 selecting quality and 6 selecting scopes as the third constraint of the project triangle.

Traditional industries still define the project using the triple constraint model of the project triangle. This is the reason why the term "iron triangle" also appears in the literature, which various authors associate with project performance criteria. Therefore, even after 2020, the theoretical and methodological core of the "iron triangle" remains a paradigm that offers a model for the further development of scientific thought. Namely, a pattern was established that traditional industries, such as e.g. construction with large investment projects and industry production that is increasingly high-tech oriented, are the biggest proponent of triple constraints according to the classic project triangle model. On the other hand, the modern industries, IT, the event industry, etc. do not bring to the fore triple project constraints, but rather soft, external criteria that go beyond traditional project constraints. Performance criteria, which include sustainable development, environmental impacts, efficiency in all respects, and effects on society, are also being increasingly enforced. However, regardless of what the project constraints are and what the project management approach is - whether it is a traditional or agile approach, if the project constraints and/or success criteria are well defined and

controlled during the project implementation phase, they have a positive impact on project performance.

Project constraints according to the project triangle model give traditional industries a solid foundation for a successful project, hence the term "iron triangle". Following our previous expectations, we found with the SR review that even after 2020 there is a connection between project constraints and the success of projects or success factors because the majority of authors in their studies indicated both individual project constraints and at least one of them that define the project, as well as the success of the projects. Based on the above, we conclude that project constraints and project success should be related, i.e. success factors should come from project constraints, as they define the project as a whole.

We noticed that the authors are defining more and more other project success criteria, which are not necessarily project constraints at the same time. Satisfaction is a key factor in the success of projects, which is studied as the satisfaction of several different stakeholders who appear during the implementation of projects and in one way or another influence it or are only its external observers. Each stakeholder has a unique perception of the constraints that determine the project, as well as the success of the project itself, so it will be welcome to research stakeholders and their perception of project limitations and/or project success. The review of scientific research papers therefore confirmed the dimension of the so-called paradigm of the "iron triangle" and showed that its elements directly define project success and/or indirectly affect project success factors. Also, by reviewing case studies and research in this area, we have shown that the three traditional project constraints according to the project triangle model "cost-time-scope" are still the foundation on which we build a successful project. Most of the time, a successful project is manifested through the quality or satisfaction of clients, users, and customers, we could say all the stakeholders that a certain project concerns, therefore, when studying project management, the achievement of the goals of the various project management stakeholders and the effectiveness of the project team are becoming more and more important.

The field of researching the satisfaction and preferences of various project management stakeholders is the starting point for the optimization of various types of projects. This is the reason that our further research will be aimed at studying the perceived gap in the positioning of the third project constraint on the example of the nuclear industry, which is subject to the slogan "Safety first!". We will focus on the stakeholders of engineering projects in the nuclear industry because given the specifics of the activity, we would expect them to perceive quality as a key project constraint, which is also a criterion for a successful project. The concept of the triple constraint according to the project triangle

model from the aspect of stakeholders will help to understand whether different stakeholders perceive individual project constraints and project success differently or whether they strive for the same common goal. The identified differences in the perception of stakeholders will represent an area for optimizing project management in the nuclear industry, for systematic monitoring of project constraints, and for motivating and raising the commitment of stakeholders in the performance of project duties. As a result, all of this will enable the various stakeholders to manage more effectively and be more satisfied with the successful completion of the project. In this way, we will empirically investigate the "iron triangle" paradigm and the perceived research gap in the positioning of the scope and quality of the project on the example of the nuclear industry and involve a soft factor of success - the aspect of stakeholders, which is otherwise typical for non-traditional industries, such as healthcare, education, tourism and other services.

References

1. Adejoh, A. A., Asebiomo, M. M., Ogunbode, E. B., Oyewobi, L. O., Sani, M. A., Isa, R. B. & Jimoh, R. A. (2023). Influence of Contractor Selection Criteria on Critical Success Factors of Public Project Delivery in Abuja. *Environmental Technology and Science Journal, 13*(2), 86-98. doi: 10.4314/etsj.v13i2.10
2. Ajibike, W. A., Adeleke, A. Q., Muuka, G. N., Bamgbade, J. A., Darun, M. R. & Moshood, T. D. (2022). Impacts of Oil and Gas Internal Risk Factors on Project Success: Moderating Role of Government Support. *Construction Economics and Building*, *22*(1), 47-69. doi: 10.5130/AJCEB.v22i1.7842
3. Alade, T. A., Bukoye, O. T, Roehrich, J. K. & Edelenbos, J. (2022). Cross-national collaboration in strategic transport projects: The impact on benefits realization. *International Journal of Project Management*, *40*(4), 411-425. doi: 10.1016/j.ijproman.2022.03.009
4. Al Mokhtar, M. A. S. & Mazen, M. F. (2021). The Impact of Transformational Leadership Factors on Project Progress and which Factor has Significant Influence and Great Contribution towards Project Success. *Webology*, *18*(4), 1389-1412. doi: 10.14704/WEB/V18SI04/WEB18205
5. Amora, V. C. M. & Juanzon, J. B. P. (2022). A Framework of Critical Success Factors and Success Criteria for Structural Works of a Mixed-Use Building Construction Project. *Civil Engineering and Architecture, 10*(1), 267-279. doi: 10.13189/cea.2022.100123
6. Bond, S. S. (2022). *International Development Project Strategies to reduce the Negative Impact of Triple Constraints* (Master's dissertation). Walden University, USA
7. Borsuk, B. J. (2022). *Manufacturing Execution Systems Project Success* (Doctoral dissertation). Faculty of Saint Leo University, USA
8. Byers, S. (2022). *Large Construction Projects – Measuring Success Through Different Stakeholders's Eyes* (Doctoral dissertation). University of Western Australia, Australia
9. Bukoye, O. T., Ejohwomu, O., Roehrich, J. & Too, J. (2022). Using nudges to realize project performance management. *International Journal of Project Management, 40(8),* 886-905. doi: 10.1016/j.ijproman.2022.10.003

10. Bursaw, C. J. (2022). *Effects of Traditional and Agile Project Management: Analysis for Project Succes in Noniformation Technology Environments* (Doctoral dissertation). Faculty of Saint Leo University, USA
11. Cardella, C. (2022). *Project Termination Quality and its Influence on Organizational Learning and Project Management Success* (Doctoral dissertation). University of North Carolina at Charlotte, USA
12. Clark, J. M. (2021). *The Extent of Project Management Competencies and Project Complexity on Project Success: a Correlation Study* (Doctoral dissertation). Capella University, School of Business and Technology, USA
13. Egboga, I. & Cross, O. D. (2022). How relevant is the iron triangle as a measure of construction project performance. *World Journal of Management and Business Studies*, *2*(1), 1-14.
14. Essien, I. O. (2021). *Modelling Project Complexity for Leadership Decision-making and Success in the Building Construction Industry in Lagos, Nigeria* (Doctoral dissertation). Oxford Brookes University. Lagos, Nigeria.
15. Girma, B. H. (2021). *The Practice of Monitoring and Evaluation in Ethiopian Road Projects: The Case of Federal Road Projects* (Master's dissertation). St. Mary's University, Addis Ababa, Ethiopia
16. Highsmith, J. (2009). *Agile Project Management: Creating Innovative Products* (2nd ed.). Pearson Education.
17. *How Agile Keeps Projects on Track, On Time, On Budget*. Vertical motion. Retrieved from https://www.verticalmotion.ca/how-agile-keeps-projects-on-track-on-time-on-budget/
18. Hussain, A., Jamil, M., Farooq, M. U., Asim, M., Rafique, M. Z. & Pruncu, C. I. (2021). Project managers' personality and project success: Moderating role of external environmental factors. *Sustainability (Switzerland)*, *13*(16), art.9477, 1-22. doi: 10.3390/su13169477
19. Hussain, D. A., Khan, G. A., Khan, D. J. A. & Khan, M. I. (2022). Project Success Factors and Project Management: Empirical Evidence from Pakistan. *International Journal of Business and Management Sciences, 3*(2), 67-79. Retrieved from https://www.ijbms.org/index.php/ijbms/article/view/219
20. Ika, L. A. & Pinto, J. K. (2022). The "re-meaning" of project success: Updating and recalibrating for a modern project management. *International Journal of Project Management, 40*(7), 835-848. doi: 10.1016/j.ijproman.2022.08.001
21. Imran, M., Hye, A. K. M., Urbanski, M. & Dacko-Pikiewicz, Z. (2022). Assessment of Risk Factors and Project Success in Construction Industry. *Transformations in Business & Economics, 21(*2B(56B)), 986-1000. Retrieved from https://www.researchgate.net/publication/366901748_Assessment_of_Risk_Factors_and_Project_Success_in_Construction_Industry
22. Jayyousi, A. A. (2021*). A Critical Examination of the Relationship Between Project Management Leadership Style and Project Success in the United Arab Emirates Construction Industry* (Master's dissertation). California Southern University, California, USA
23. Kerzner, H. (2023). *Project Management Metrics, KPIs, and Dashboards. A Guide to Measuring and Monitoring Project Performance* (4th ed.). Hoboken, New Jersey: John Wiley&Sons.
24. Kumar, V., Pandey, A. & Singh, R. (2023). Project success and critical success factors of construction projects: Project practitioners' perspectives. *Organization, Technology and Management in Construction*, *15*(1), 1-22. doi: 10.2478/otmcj-2023-0001
25. Lama, N. D., Kian, M. W. & Ojha, S. K. (2022). Institutional Competence Factors Affecting Multiple Project Management Success; The Case of Nepalese Construction Industry. *International Journal of Academic Research in Business and Social Sciences, 12*(5), 1882-1906. doi: 10.6007/IJARBSS/v12-i5/13897

26. Locatelli, G., Paravano, A., Terenzi, M. & Trucco, P. (2023). Yes, construction cost, time and scope are important, but there is more: a new action plan for infrastructure success. *Management Decision, 61*(13), 413-424. doi: 10.1108/MD-04-2022-0516
27. Madsen, S. (2013, December 3). *Is the iron triangle outdated?* Retrieved from https://www.susannemadsen.co.uk/blog/the-iron-triangle-and-the-tripleconstraintsare-outdated
28. Mellado, F., Lou, E. C. W. & Becerra, C. L. C. (2020). Synthesising performance in the construction industry: An analysis of performance indicators to promote project improvement. *Engineering, Construction and Architectural Management*, *27*(2), 579-608. doi: 10.1108/ECAM-09-2018-0419
29. Moreno-Monsalve, N., Delgado-Ortiz, M., Rueda-Varón, M. & Fajardo-Moreno, W. S. (2023). Sustainable Development and Value Creation, an Approach from the Perspective of Project Management. *Sustainability (Switzerland)*, *15*(1), art. 472, 1-15. doi: 10.3390/su15010472
30. Page, M. J, McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., … Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ, 372*(71). doi: 10.1136/bmj.n71
31. Pollack, J., Helm, J. & Adler, D. (2018). What is the Iron Triangle, and how has it changed? *International Journal of Managing Projects in Business*, *11*(4), 527-547. doi: 10.1108/IJMPB-09-2017-0107
32. Salazar, L. (2018, September 13). *From iron triangle to agile triangle (extended).* Retrieved from https://www.linkedin.com/pulse/from-iron-triangle-agile-extended-luis-antonio-salazar-caraballo/?trackingId=eHMns0r0Sgafm4EpYO3oKw%3D%3D
33. Samset, K. F. & Volden, G. H. (2016a). Front-end edition of projects: Ten paradoxes and some
reflections regarding project management and project governance. *International Journal of Project Management*, *34*(2), 297-313. doi: 10.1016/j.ijproman.2015.01.014
34. Samset, K. F. & Volden, G. H. (2016b). *Front-end Definition of Major Public Projects*. Theoretical insights and conflicting practices. A selection of findings from studies conducted by the Concept Research Program. Norwegian University of Science and Technology, Trondheim. Retrieved from http://hdl.handle.net/11250/2437547
35. Shrestha, B. K. (2021). *Relationship Between Standardization Critical Success Factors (CSFs) and Project Performance* (Doctoral dissertation). University of Nevada, Las Vegas, USA
36. Sidlayiya, T. H. (2022). *The Impact of Project Control in Project Succes in the Events Industry in Cape Town* (Master's dissertation). Cape Peninsula University of Technology, Cape Town, SAR
37. Team Asana. (2024, February 15). *What is the project management triangle and how can it help your team?* Retrieved from https://asana.com/resources/project-management-triangle
38. Varajão, J., Lourenço, J. C. & Gomes, J. (2022). Models and methods for information systems projects success evaluation – A review and directions for research. *Heliyon, 8*(12), e11977. doi: 10.1016/j.heliyon.2022.e11977
39. Volden, G. H. & Welde, M. (2022). Public project success? Measuring the nuances of success through ex post evaluation. *International Journal of Project Management*, *40*(6), 703-714. doi: 10.1016/j.ijproman.2022.06.006
40. Vrchota, J., Řehoř, P., Mařiková, M. & Pech, M. (2021). Critical Success Factors of the Project Management in Relation to Industry 4.0 for Sustainability of Projects. *Sustainability 2021, 13*(1):281. doi: 10.3390/su13010281
41. Yedvav, H., Kordova, S. & Fridkin, S. (2022). Offset Obligation in Defense Projects: Schedule, Budget, and Performance Implications. *Sustainability (Switzerland)*, *14*(18), art. 11184, 1-21. doi: 10.3390/su141811184

42. Young, M. (2016). *Private vs. public healthcare in South Africa* (Bachelor's thesis). Western Michigan University, USA

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Povzetek:
Paradigma projektnega trikotnika

Ozadje in izvirnost: Projektni trikotnik, imenovan tudi trojna omejitev, železni trikotnik, zlati trikotnik in agilni trikotnik, je osrednji koncept raziskav in prakse projektnega menedžmenta, ki predstavlja razmerje med ključnimi merili uspešnosti. Vendar pa obstaja nesoglasje o tem, katera merila naj bodo predstavljena na ogliščih tega trikotnika.
Namen: Namen tega prispevka je raziskati, kateri koncepti so del projektnega trikotnika in kako so se ti koncepti skozi čas spreminjali. Naš namen je opraviti sistematičen pregled znanstvenih člankov, ki obravnavajo tematiko projektnega trikotnika in njegove elemente (čas, stroški in obseg). Dokazati želimo, da obstaja teoretična praznina v klasični teoriji projektnega trikotnika ter da se elementi projektnega trikotnika nenazadnje odražajo v uspešnem menedžiranju projektov. Obravnava te tematike bo prispevala k odpravi ali vsaj zmanjšanju zaznane teoretične raziskovalne vrzeli oz. zmede glede pozicioniranja elementov projektnega trikotnika ter povezave teh elementov na uspešnost projektov.
Metoda: Sistematičen pregled znanstvene literature bo izveden po javno dostopnih bazah podatkov, in sicer smo kot iskalne pojme uporabili »železni trikotnik«, »trojna omejitev«, »uspešnost projekta« in »dejavniki uspeha«. Znanstvene članke in doktorske/magistrske disertacije smo poiskali v bazah Academia.edu, ProQuest, ScienceDirect, Elsevier/Scopus in Google Scholar. Izločili smo literaturo, ki se neposredno ne nanaša na področje raziskovanja.
Rezultati: Ugotovili smo, da obstaja v osnovni teoriji projektnega trikotnika praznina oz. zmeda glede pozicioniranja kakovosti in obsega projekta v projektnem trikotniku. Želimo torej zmanjšati vrzel in potrditi tezo, da kakovost ni eden od 3 elementov projektnega trikotnika, ampak je posredno definirana skozi elemente projektnega trikotnika (čas, stroški, obseg). Avtorji do sedaj izvedenih raziskav so navedli elemente projektnega trikotnika in po skupinah definirali merila uspešnosti projektov, med katere so uvrstili posamezne elemente projektnega trikotnika. Pričakujemo, da bomo potrdili hipotezo, da obstaja povezava med elementi projektnega trikotnika in uspešnostjo projektov.
Družba: Naša raziskava bo potrdila razsežnost koncepta projektnega trikotnika in pokazala vpliv njegovih elementov na najpogostejše skupine meril uspešnosti, s pomočjo katerih družbe merijo uspešnost projektov. Ta raziskava bo pokazala, katerim elementom projektnega trikotnika in meril, pripisuje znanstvena literatura večji pomen, kar predstavlja izhodišče za optimizacijo na področju menedžiranja različnih vrst projektov.

Izvirnost: Razumevanje koncepta železnega trikotnika in njegove vloge pri oblikovanju meril uspešnosti bo pripomoglo, da bodo različni deležniki, ki so vpeti v menedžiranje projektov, bolj motivirani za spremljanje elementov projektnega trikotnika, da jim bo to omogočalo bolj učinkovito menedžiranje, kar posledično vpliva tudi na njihovo zavzetost pri opravljanju projektnih zadolžitev.
Omejitve/nadaljnje raziskovanje: Obravnavana tematika je dobro preučevana zadnjih 20 let, čeprav se je teoretično zelo preoblikovala. Istočasno opažamo, da teoretični obravnavi ne sledijo znanstvene raziskave, saj le-te pokrivajo predvsem področje metodologije, faktorjev in strategij uspešnosti projektnega menedžmenta v gradbeništvu oz. na velikih investicijskih projektih, področju IT in zdravstvene dejavnosti. Predlogi za nadaljnje raziskovanje bodo podani v smeri, da se raziskava te tematike izvede v drugih panogah in drugih vrstah projektov ter na več različnih deležnikih in/ali deležniških skupinah, ki so vpete v menedžiranje projektov.

Ključne besede: projektni menedžment, projektni trikotnik, trojna omejitev, železni trikotnik, agilni trikotnik, uspešnost projekta, dejavniki uspeha.